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Measurement and Analysis of Drilling Vibration Using Tracer DAQ and LABVIEW

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Abstract- This study presents a vibration measurement system using Micro-Electro-Mechanical Systems (MEMS) accelerometer design to measure the vibration of a vibration source. The LABVIEW program is developed to monitor and analyze measured data. The program first acquires the analogue input signal from the three different channels, and reads the data to be analyzed. The obtained measurement data during the measurement is illustrated graphically by means of Tracer DAQ and LABVIEW. Therefore, as a result of the analysis, vibration data obtained by means of two different programs are compared. Some preliminary results of this endeavor are presented. The error evaluation of these accelerometers has been performed according to the Mean Absolute Percentage Error (MAPE) method. In the conducted evaluation, Accelerometer (Acc) 1 is 0.033%, Acc 2 is 0.019% and Acc 3 is 0.055%. We have reached that findings of proposed study are similar.

Keywords- Data acquisition; vibration analysis; vibration monitoring; accelerometer.

1. Introduction

Developing technology, vibration reduction and insulation methods have been an integral part of the machine design and as a result, the need for accurate measurement and analysis of vibration is emerged. Years ago, this requirement could be met with simple optical instruments of experienced engineers, which measures listening touch senses and displacement. However, nowadays very fast and as result of vibration forces are too large for the machine, vibration measurement methods and tools have been developed and are being used.

This paper investigates the vibration on cutting tools, especially on the drill bits, during the cutting operation. As the importance of full automation in the industry has gained substantial importance, vibration monitoring during the cutting operation has been the subject of many investigators (Ertunç and Sevim, 2001; Ertunç, 1999; El-Wardany et al., 1999; Stein et. al., 2007; Fan and Qiao, 2011). Vibration, is the one of the most common and bothersome problems affecting drilling performance. Successful drilling processes requires the proper understanding of how to minimize vibration to efficiently maximize production, drill life, and production quality. Excessive vibrations interfere with production quality and may cause the mechanical and/or electronic drill equipment to malfunction. Hence, it is worthwhile to undertake technical efforts to minimize vibrations. It is necessary and valuable to be able to assess the importance of vibration abatement

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measures and to assess their effectiveness as a means for reliable measurement (Zou et al., 2000; Paddan and Griffin, 2002; Doebelin, 2003; Anon, 2011; Stein et. al., 2011).

2. The Measurement Compact System

To facilitate the single-axis vibration measurement in field conditions, a low-cost apparatus was developed from the commercially available MEMS acceleration sensors. The aim behind the project was to have the in-house facilities to perform the field measurements within reasonable costs without the need for specialized equipment and for a specialized test engineer. The purpose of this system is:

- To gather real-time field vibration data for future use in the drilling operation system simulation research.
- To have the means to analyze the drilling vibration concurrently.

In this way, the various interactions could be analyzed in each material. The research effort could then focus on vibration mitigation in the axis of the highest influence (acceleration value). This is not necessarily in the vertical axis.

This study designed and constructed a compact measuring system employing three single-axis MEMS accelerometers interfaced via a Measurement Computing's USB-1208FS data acquisition device to a laptop. The vibration signals generated in the process of drilling was measured using a MEMS accelerometer (ADXL103-CE, AD22280). The digitized data were then processed in Tracer DAQ® software and popular virtual instrument (VI) development workbench LABVIEW to analyze the vibration. The program first acquires the analogue input signal from the three different channels, and read the data to be analyzed. The obtained measurement data during the measurement was graphically illustrated by means of TRACER DAQ, LABVIEW. Therefore, as a result of the analysis, the vibration data obtained by three different programs are compared. Some preliminary results of this endeavor are presented. The error evaluation of these accelerometers was performed according to the Mean Absolute Percentage Error (MAPE) method. In the conducted evaluation, Accelerometer 1 (ACC 1) was 0.033%, Accelerometer 2 (ACC 2) was 0.019%, and Accelerometer 3 (ACC 3) was 0.055%.

The compact vibration measuring system consists of the following parts (see Fig. 1):

Fig.1. Photo of the sensors and DAQ device box with the laptop.

A/Three identical single-axis MEMS accelerometers; B/A Measurement Computing's USB-1208FS DAQ device; C/-A standard laptop with an acquisition program.

A/ The three-component MEMS accelerometer type ADXL103NE-CD and AD22280, are available in a 5 mm × 5 mm × 2 mm, 8-terminal ceramic LCC package. ADXL103NE-CD and AD22280 are low power, complete single-axis accelerometers with signal conditioned voltage outputs, all on a single, monolithic

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IC. They measure acceleration with a full-scale range of relatively ± 1.7g and ± 50g; the output voltage is approx. 3.5 V to 6 V for zero acceleration. Temperature range is relatively –40°C to +125 °C and –40°C to +105 °C. They can measure both dynamic acceleration (vibration) and static acceleration (gravity). The accelerometers are factory calibrated, hence no field calibration is needed.

The accelerometers are fixed to a 10 mm thick cold-drawn plain of 60×180 mm. The accelerometers are positioned both at the edges and center, and seen in Fig. 2.

Accelerometer (Acc) 1, type AD22280, is positioned at the center, and Acc 2 and Acc 3, type ADXL103, are positioned at the edges (Fig.2).

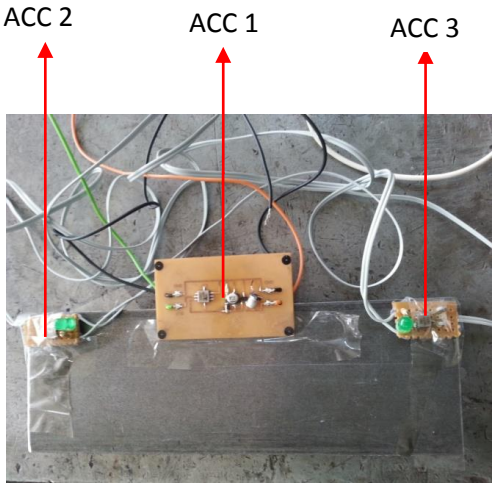

Fig. 2. Position of the accelerometers.

B/ USB-1208FS is a simple and low-cost multifunction I/O device from Measurement Computing. The device consists of eight analog inputs, two analog outputs, and 16 digital I/O connections. It can easily connect to a computer or external USB hub to create the application, and no extra power-supply is needed. To create the DAQ application, requires a programming development tool, such as Visual Studio/C#, or LABVIEW. DAQ applications include acquire data, display, trigger, control, analysis, math, statistics, alarming, save data, and more.

C/ A simple data logging software was designed and developed using Tracer DAQ and LABVIEW VI. The software can perform the following functions:

Acquire analog input signal from different channels.

- Display time domain signal.
- Study the effects of windows on the acquired data
- Display the signal spectra.

The program first acquires the analog input signal from the three different channels, and reads the data to be analyzed.

3. Measurement Vibration Using TRACERDAQ

Tracer DAQ is an out-of-the-box application that can generate, acquire, analyze, display, and export data within seconds of installing the Measurement Computing data acquisition hardware. Tracer DAQ includes a strip chart, an oscilloscope, a function generator, and a rate generator, all of which are accessed through a common, easy-to-use interface.

The vibration acceleration is obtained and displayed (Fig. 3).

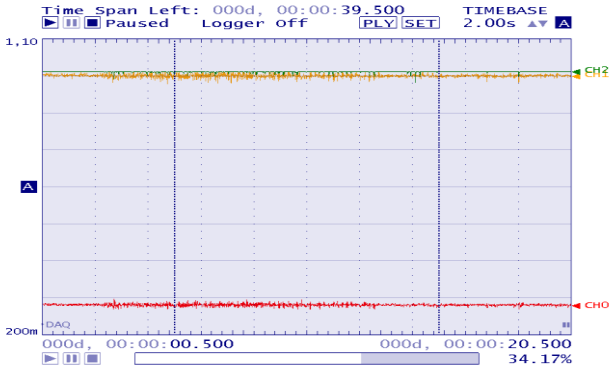

Fig.3. Vibration acceleration signals acquired with Tracer DAQ.

Table 1 illustrates the measured values acquired with the Tracer DAQ during drilling operation.

Table 1. Measured values acquired with the Tracer DAQ during the drilling operation.

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Acc 1	Acc 2	Acc 3
0,2918	0,9858	0,9858
0,2879	0,9912	0,998525
0,2889	0,9829	0,992660
0,286	0,9961	0,998541
0,2923	0,9805	0,968292
0,2876	0,9925	0,902168
0,3011	0,9893	1,011273
0,2908	0,9785	1,059067
0,2928	0,9907	0,973610
0,3006	0,9805	0,951203
0,2918	0,9888	0,981476
0,2781	0,9839	1,049818
0,2928	0,9897	1,026321
0,2908	0,9893	0,974652
0,2894	0,9844	1,011255
0,2884	0,9873	0,899409
0,2874	0,9863	0,993625

4. Measurement Vibration Using LABVIEW

LABVIEW is a software development platform that can be programmed with a graphic interface. LABVIEW software is ideal for any measurement or control system. LABVIEW is used in applications requiring data acquisition and it offers quite flexible choices to its users for data evaluation and monitoring.

In this study, data taken from the Measurement Computing's USB-1208FS DAQ device can be evaluated instantly on the computer, and graphs can be created and stored via LABVIEW in order to compare in the subsequent measurements. Fig. 4 presents the block diagram of program with LABVIEW.

Fig. 4. The block diagram of the program with LABVIEW.

Table 2 illustrates the measurements acquired with the LABVIEW values during the drilling operation.

Table 2. Measured values acquired with the LABVIEW during the cutting operation.

Acc 1	Acc 2	Acc 3
0,297852	0,98877	0,98877
0,29541	0,983887	0,976562
0,29541	0,983887	0,974121
0,29541	0,976562	0,974121
0,288086	0,976562	0,98877
0,26123	0,922852	1,013184
0,283203	0,97168	0,949707
0,307617	1,020508	0,939941
0,307617	0,983887	1,000977
0,290527	1,015625	1,044922
0,29541	0,966797	0,974121
0,283203	0,996094	0,930176
0,300293	1,032715	0,996094
0,290527	0,983887	0,998535
0,29541	0,976562	0,949707
0,300293	0,964355	1,052246
0,297852	0,983887	0,976562

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5. Comparison of TracerDAQ with LABVIEW

Total error percentage of the measured values of Tracer DAQ and LABVIEW are carried out to the "Mean Absolute Percentage Error (MAPE)" method. The Mean Absolute Percentage Error equation is (Nahmias, 1997; Lurgio, 1998):

$$\text{MAPE} = \left[\left(\frac{1}{n}\right)\sum_{i=1}^{n}\left|\frac{e_i}{D_i}\right|\right]\times 100 \qquad (1)$$

n = Measurement number
e_i = i'th error value

D_i= i'th measurement value

Measured values by means of Acc 1, which were acquired with LABVIEW and Tracer DAQ, are seen in Figure 5.

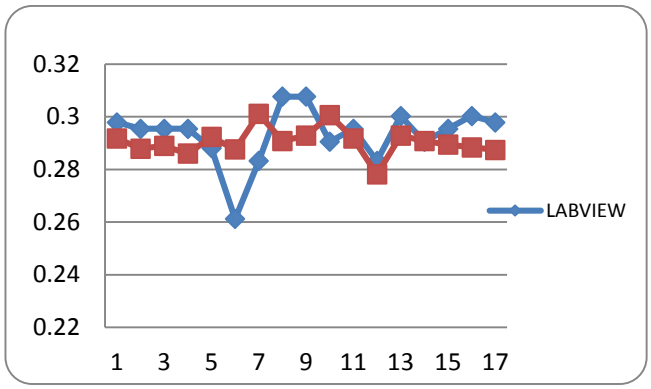

Fig. 5. Comparison of measured values via LABVIEW and Tracer DAQ for Acc 1.

As seen in the Figure 5, Mean Absolute Percentage Error for Acc 1 is 0.033 %. Measured values by means of Acc 2, which were acquired with LABVIEW and Tracer DAQ, are seen in Figure 6.

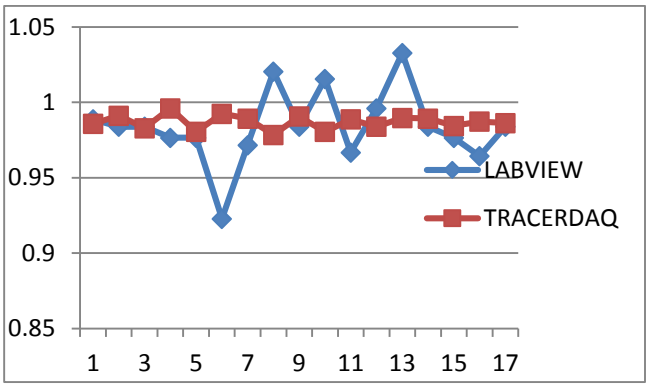

Fig. 6. Comparison of measured values via LABVIEW and Tracer DAQ for Acc 2.

As seen in Figure 6, Mean Absolute Percentage Error for Acc 2 was 0.019 %. The measured values by means of Acc 2, which were acquired with LABVIEW and Tracer DAQ, are seen at Figure 7.

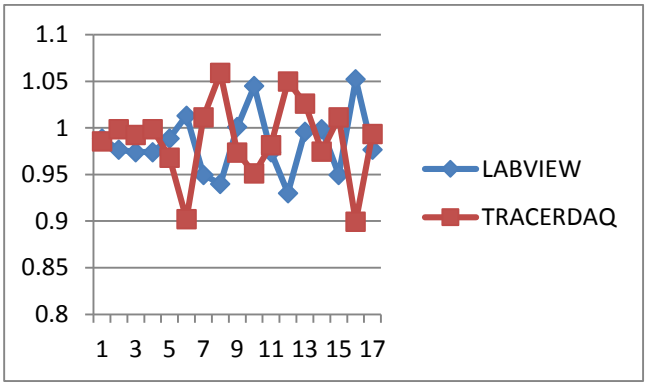

Fig. 7. Comparison of measured values via LABVIEW and TracerDAQ for Acc 3.

As seen in Figure 7, Mean Absolute Percentage Error for Acc 3 was 0.055 %.

6. Conclusion

Vibration measurement; both the maintenance-repair work and for the health of the employees a very important in the work places.

The vibration meter, depending on the machines if that machine vibrations outside of standard maintenance time has come. In a worker exposed to excessive vibration white finger and carpal tunnel disease occurs.

As a result of the analysis, vibration data obtained by the means of two different programs were compared.

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The error evaluation of these accelerometers was performed according to the Mean Absolute Percentage Error (MAPE) method. In the conducted evaluation, Accelerometer (Acc) 1 was 0.033%, Acc 2 was 0.019%, and Acc 3 was 0.055%. The results were similar (Table 3).

Table 3. Mean Absolute Percentages Error for Acc 1, Acc 2 and Acc 3.

	Mean Absolute Percentage Error
Acc 1	0.033 %
Acc 2	0.019 %
Acc 3	0.055 %

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Does Military Integrated Product Team Performance Predict Commercial Cost Reduction Program Success?

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Abstract In the early 1990s, U.S. military leaders began to copy commercial enterprises by assembling integrated product teams (IPTs) to adapt and implement commercial cost reduction programs (CCRPs) for military organizations. However, no evidence was present in the literature that military IPT performance was related to CCRP success. A non-experimental, quantitative correlational study was conducted to determine whether or not a relationship existed between military IPT performance and CCRP success. A questionnaire distribution yielded 80 acceptable responses, and Spearman's rank order correlation and ordinal regression were employed for correlation and predictor significance analyses, respectively. The Spearman's correlation coefficient analysis results revealed a strong positive relationship between the IPT Performance and CCRP Success ($r_s = 0.70$, $p < 0.01$). The correlation coefficients between each of the six variables of IPT Performance and CCRP Success were IPT Communication ($r_s = 0.64$, $p < 0.01$), IPT Coordination ($r_s = 0.57$, $p < 0.01$), IPT Balance of Member Contributions ($r_s = 0.51$, $p < 0.01$), IPT Mutual Support ($r_s = 0.65$, $p < 0.01$), IPT Effort ($r_s = 0.36$, $p < 0.01$), and IPT Cohesion ($r_s = 0.67$, $p < 0.01$). The ordinal regression analysis yielded three significant predictors, IPT Coordination (Estimate = 0.23), IPT Effort (Estimate = -0.40), and IPT Cohesion (Estimate = 0.24). Military managers should first assess whether or not their organizational systems are conducive to hosting IPTs and whether or not their organizations contain the necessary resources for hosting IPTs. Future researchers should employ a larger sample and a qualitative study to observe team interactions for identifying the characteristics of teams and team members.

Keywords- Commercial cost reduction programs; integrated product teams; military; team performance; program success; integrated product; and process development.

1. Introduction

Increased global market competition and cuts in military budgets have led business and military leaders to develop and implement programs to reduce costs. These leaders used different approaches such as Lean, Just-in-Time, Six Sigma, warehouse management systems, transportation management systems, equipment redesign, and critical chains to implement cost reduction programs. To facilitate knowledge sharing, the U.S. Department of Defense (DOD) initiated the concept of integrated product and process development (IPPD) in the early 1990s.

The IPPD is a management technique that: (a) utilizes multidisciplinary teams to simultaneously integrate all activities to optimize the design, manufacturing, and supportability processes; (b) is implemented using integrated product teams (IPTs), which are teams established by organizational managers; and (c) consists of employees well qualified in their particular areas of required expertise (Blanchard & Fabrycky,

2011). Military IPTs in this study were ad hoc teams assembled by a program manager or other management official to address certain well-defined designated issues as suggested by Blanchard and Fabrycky (2011). Knowledge sharing through communication channels and high-quality teamwork may be crucial for the success of military organizations adapting and implementing commercial cost reduction programs (CCRPs).

2. Research Problem and Purpose

U.S. government leaders agreed to cut $350 billion from the military budget for 10 years starting in 2011 (The White House, 2011). However, as a result of the Budget Control Act, the reduction may become much higher (U.S. Congress, 2011). On March 1, 2013, President Obama signed a presidential order implementing the Budget Control Act, resulting in employee furloughs in 2013 (Robins Air Force Base, 2013). On December 26, 2013, President Obama signed a budget for 2014 (The White House, 2013), negating the Budget Control Act of 2014. The problem addressed in this study was that the U.S. military required programs that would accommodate smaller budgets (U.S. Congress, 2011) and fewer personnel (Howe, Theole, Pendley, Antoline, & Golden, 2009). The use and levels of performance of IPTs may be crucial for the successes of military CCRPs; however, U.S. military leaders were not sure whether IPT performance is a good predictor of the success of CCRPs.

The purpose of this non-experimental, quantitative correlational study was to determine the existence, strength, and direction of a probable relationship between IPT Performance levels and the success levels of military adapted CCRPs. A research instrument, HGMIL, was used to measure the variables IPT Performance and CCRP Success. The IPT Performance variable consisted of six predictor variables: IPT Communication, IPT Coordination, IPT Balance of Member Contributions, IPT Mutual Support, IPT Effort, and IPT Cohesion. The IPT Performance variable, containing 37 items, was created from the six facets of team work quality (TWQ) (Hoegl & Gemuenden, 2001). The CCRP Success variable, containing 15 items, was created from team performance (Hoegl & Gemuenden, 2001). The Spearman's correlation was used to assess the relationship between IPT Performance and CCRP Success, and between each predictor variable and CCRP Success. Ordinal regression was used to identify which predictor variables were significant.

3. Research Question and Method

Q1. What is the relationship, if any, between the IPT Performance level and the CCRP Success level in military organizations?

From this research question, the hypotheses were:

H_0. There is no statistically significant relationship between the IPT Performance level and the CCRP Success level in military organizations.

H_a. There is a statistically significant relationship between the IPT Performance level and the CCRP Success level in military organizations.

The survey request reached more qualified respondents within a shorter timeframe than would have been possible with any other means of distribution. The following were the steps employed in accomplishing the study:

1. An existing web-based instrument, HGMIL, was hosted by SurveyMonkey to collect data.

2. A convenience sample of subjects from Northcentral University, the International Society of Logistics, Embry-Riddle Aeronautical University, Robins Chiefs Group, and LinkedIn was selected. The targeting of organizations most likely to contain members or students with experience as IPT members or leaders in CCRP adaptation appeared to be the best method of identifying qualified respondents. The use of organizational email and organizational web site postings also appeared to be the most expedient methods of obtaining qualified respondents.

3. Approval to invite subjects and to collect data was requested to and obtained from leaders of the participating organizations.

4. Approval to collect data was requested and obtained from an Institutional Review Board (IRB) prior to data collection.

5. A pilot study of the HGMIL was accomplished at the Robins AFB, Ga. campus of Embry-Riddle Aeronautical University Worldwide. The pilot study was necessary in order to find and correct any problems prior to administering a larger HGMIL distribution. HGMIL was emailed to the Assistant Director, faculty, and students using Embry-Riddle Aeronautical University email with the intention of receiving 10 to 15 completed responses. The pilot study had to include

respondents covering the three branches of the U.S military. The pilot study ran for 10 days and 12 useable responses were received. There were no HGMIL problems identified by the respondents.

6. The data collection time period was four months, during which 80 useable responses were received.

7. Data were analyzed using Spearman's correlation, individual and item mean averages, and ordinal regression, and then the findings were composed.

The population for this study was limited to personnel who previously served as IPT leaders or IPT members for adapting CCRPs in U.S. military organizations. These members and leaders served as military personnel, government civilians, and/or contractor civilians during IPT functions. As suggested by Blanchard and Fabrycky (2011), IPT members should possess qualities such as having the appropriate discipline(s) necessary to investigate a specific segment of design, the ability to effectively work together in order to provide solutions for outstanding problems, and the ability to design activities.

4. Assumptions, Limitations, and Delimitations

The population of former IPT leaders and members adapting CCRPs is assumed to be extremely small in comparison with the total population of current or former U.S. military and civilian personnel serving on IPTs. One reason for the small population is that team leaders and members must be highly knowledgeable in the specific fields that are required for IPT membership (Blanchard & Fabrycky, 2011). In order to achieve accurate responses, response bias, which occurs when a respondent consciously or unconsciously misrepresents the truth (Zikmund, Babin, Carr, & Griffin, 2013), should be minimized. Response bias may be problematic in military cultures by the reporting of a more positive view of program success, as opposed to how the program actually fared (McAneny, 2010). In order to mitigate response bias, HGMIL did not include a request for the respondent's name or the name of the program, and the use of SurveyMonkey ensured confidentiality. In order to mitigate a relatively small sample, steps were taken to limit bias and sample error.

The seminal study captured both task-related and social interactions within teams; however, the contents of team tasks or activities, such as measuring the content of communications, were not measured (Hoegl & Gemuenden, 2001). Leadership processes such as goal setting, task planning, task controlling, performance appraising, and feedback were not within the scope of the TWQ concept (Hoegl & Gemuenden, 2001). These limitations were, therefore, present in this study.

The limitation of team size to a minimum of three persons was necessary in defining a team. The limitation of respondents to first tier IPT members and leaders was necessary for accurately rating CCRP Success. These respondents should have first-hand knowledge of the IPT that produced the CCRP plan and the resulting CCRP Success. Sub-tier members may only have knowledge of their particular team, and these teams may disband prior to CCRP plan execution without the members learning whether, overall, the CCRP was successful or less than successful.

5. Operational Definitions of Variables

IPT Performance (X). The IPT Performance variable consisted of the Hoegl and Gemuenden (2001) Teamwork Quality facets for IPT Communication, IPT Coordination, IPT Balance of Member Contributions, IPT Mutual Support, IPT Effort, and IPT Cohesion. There were 37 items in this scale. The items were rated on a 5-point Likert scale as Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly Disagree = 1. The total IPT Performance scale was computed as the sum of the responses of the 37 items after reverse scoring items 13, 15, 16, 23, 26, 38, and 42. This variable was measured on an interval scale.

CCRP Success (Y). CCRP Success, the criterion variable, represented the results of how CCRPs fared after approximately one year following implementation. CCRP Success was measured by Team Performance items (Hoegl & Gemuenden, 2001), which were items 47 through 61 in Section II of Appendix B. Each of the 15 items was rated on a 5-point Likert scale as Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly Disagree = 1. CCRP Success did not contain any items that were reverse scored.

6. Literature Review

This study concerns the U.S. military management success of CCRP adaptations through the use of IPTs. In the current study, the six TWQ facets (Hoegl & Gemuenden, 2001) were used to measure teamwork performance. IPT Performance consisted of IPT Communication, IPT Coordination, IPT Balance of Member Contributions, IPT Mutual Support, IPT

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Effort, and IPT Cohesion. Hoegl and Gemuenden (2001) tested TWQ only within the software development industry. A later study by Dayan and Di Benedetto (2009), however, used the Hoegl and Gemuenden (2001) TWQ facets to measure teams in telecommunications, food, material, software, machinery, chemical, and service technology industries. In both of these studies, the researchers apparently assumed that all team members had sufficient qualifications to achieve product success.

In the Hoegl and Gemuenden (2001) study, the participants included team leaders, team members, and project managers; however, the managers were external to the teams. The inclusion of team member, team leader, and project manager study participants enabled a direct measurement of TWQ. Dayan and Di Benedetto (2009), however, used only product managers for respondents. The success criterion included items such as, scope, schedule, and customer satisfaction (Hoegl & Gemuenden, 2001).

Integrated Product and Process Development

The IPPD concept includes integrated design and production practices, such as concurrent engineering (CE) objectives and team member empowerment (Blanchard & Fabrycky, 2011). Industry leaders' initial implementations of IPPD in the early 1980s expanded CE concepts to include all disciplines associated with the design, development, manufacture, distribution, support, and management of products and services (Blanchard & Fabrycky, 2011). In the early 1990s, the DOD initiated the concept of IPPD, which promotes communication and integration of key functional areas that apply to various phases of program activity (Blanchard & Fabrycky, 2011).

The IPPD process may be tailored for each program, which may lead to different types of phases in which a CCRP may be deployed. For example, only two phases, implementation and post-implementation, were required for the deployment of a non-developmental enterprise resource planning system (Jean-Baptiste, 2009). The implementation phase referred to all necessary effort to place the system into use, including installation, testing, and debugging, while the post-implementation phase referred to the period following successful system installation, implementation, and subsequent requirements for maintenance and improvements (Jean-Baptiste, 2009). Other developmental requirements may be unique to the particular product or process designed.

Integrated Product Teams

A reason for assembling teams is that increasing technical complexities in the business world have caused managers to solicit employee input prior to making decisions (Schein, 2009). An IPT is a multidisciplinary group with the objective of addressing certain designated, well-defined issues, and IPTs consist of qualified individuals who are able to work together (Blanchard & Fabrycky, 2011). The reasons for establishing teams include investigating a specific design, problem solving, and other functions (Blanchard & Fabrycky, 2011).

The benefits of using the CE team method of problem solving include reductions in development cycle time, product life-cycle costs, and engineering changes in the later stages of product development (Boyle, Kumar, & Kumar, 2006). CE success requires team member representation throughout the entire program design process to maximize team member understanding of all relative information (Belay, Helo, Takala, & Kasie, 2011). The extent of functional representation on CE teams had a positive effect on communication quality, and the use of CE teams enhanced communication within organizations (Boyle et al., 2006). A commercial form of an IPT is the new product development team, which focuses on speed-to-market and product success (Dayan & Di Benedetto, 2009).

The U.S. government may use IPTs for both problem solving and contracting services. A contracting team is composed of government employees referred to as contracting officer representatives, who may serve during contract planning, contract formation, and contract management (U.S. Merit Systems Protection Board, 2005). The duties of the contracting officer representatives include serving on panels (i.e., IPTs) for evaluating proposals and bids, performing technical reviews of contractor proposed changes, and providing technical information (U.S. Merit Systems Protection Board, 2005).

Teamwork Quality Facets

Communication. Communication has been defined as "the extent to which there is sufficient frequent, formal, informal, direct, and open communication" (Dayan & Di Benedetto, 2009, p.131). Communication is the most elementary facet of TWQ, and team members should have direct communication with all other team members (Hoegl & Gemuenden, 2001). A lack of team member openness (i.e., withholding important

information) hinders the integration of team member knowledge and experience (Hoegl & Gemuenden, 2001). The reduction of informal communication within a team will lead to reduced frequency of communication, and may harm TWQ since teams will not be able to acquire the full set of information possessed by individual team members (Dayan & Di Benedetto, 2009). The object of communication is to ensure that all team members understand each team member's statements or proposals (Fruchter & Courtier, 2011).

Coordination. Coordination has been defined as "the extent to which individual efforts are well structured and synchronized within the team" (Dayan & Di Benedetto, 2009, p.131). Coordination means that teams must develop and agree on a common task-related goal structure that has clear subgoals for each team member that is free of gaps and overlaps (Hoegl & Gemuenden, 2001). The coordination of project activities, such as team autonomy and flexibility to adapt, related strongly to organizational support (Drouin, Bourgault, & Gervais, 2010).

Balance of Member Contributions. Balance of member contributions has been defined as "the extent to which team members are able to bring in their expertise to their full potential" (Dayan & Di Benedetto, 2009, p.131). The interrelatedness and current status of team member contributions also determines the quality of teamwork performed, and many activities should be delegated to individual members working on parallel tasks (Hoegl & Gemuenden, 2001). The sharing of task-related knowledge is critical for teams with innovative tasks, as these teams often have members whose expertise is in different areas (Hoegl & Gemuenden, 2001). A cross-functional team may not function properly if some members could not share ideas; therefore, idea sharing is essential to TWQ in that team member contributions are balanced with respect to each member's specific knowledge and experience (Hoegl & Gemuenden, 2001).

Mutual Support. Mutual Support has been defined as "the extent to which team members help and support each other in carrying out their tasks" (Dayan & Di Benedetto, 2009, p.131). The intensive collaboration of team members depends on a cooperative rather than competitive mind set, and competitive behavior in a team leads to distrust and frustration (Hoegl & Gemuenden, 2001). Mutual Support in teams fosters the integration of team member expertise and is, therefore, a critical aspect of quality team collaboration (Hoegl & Gemuenden, 2001). Mutual Support within a team is more likely to occur in a climate where team members feel that decision makers are unbiased and free of deception (Dayan & Di Benedetto, 2008).

Effort. Effort has been defined as "the extent to which team members exert all efforts to the team's tasks" (Dayan & Di Benedetto, 2009, p.131). It is important for everyone on the team to know and accept the work norms concerning sufficient efforts in order to achieve high TWQ and avoid conflict among team members (Hoegl & Gemuenden, 2001). A uniformly high level of effort by all team members is fundamental to the quality of collaboration (Hoegl & Gemuenden, 2001). Team leaders have an effect on team effort, as team leader knowledge and consistency were antecedents of authentic leadership. These factors affected team member satisfaction with the leader, improved organizational commitment, and, as a result, promoted extra effort by team members (Peus, Wesche, Streicher, Braun, & Frey, 2012).

Cohesion. Cohesion has been defined as "the extent to which team members are motivated to maintain the team" (Dayan & Di Benedetto, 2009, p.131). High TWQ may not be achieved without an adequate amount of team cohesion, and the members' desires to keep the team going will decrease if team members lack cohesion (Hoegl & Gemuenden, 2001). An adequate level of cohesion is also required for team members to collaborate (Hoegl & Gemuenden, 2001). Team cohesion links team member contribution and effort with team ability to reach a timely decision (Dayan & Di Benedetto, 2009). Cohesiveness between team members was positively related to intelligence and skills (Al-Rawi, 2008).

7. Results and Evaluation of the Findings Power, Reliability, and Test of Normality

In order to determine if the number of useable responses received was sufficient, a post hoc G*Power analysis using a medium effect size estimate (equal to a G*Power calculated odds ratio of 2.33), a two-tailed test, an alpha level of 0.05, and a total sample size of 80 yielded a power level of approximately 0.88. An a priori G*Power analysis using a medium effect size estimate (equal to a G*Power odds ratio of 2.33), a two-tailed test, an alpha level of 0.05, and desired power of 0.80 indicated that 67 participants would be required.

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Cronbach's Alpha was used to determine the reliability for IPT Performance, CCRP Success, and for each of the six predictor variables. IPT Performance reliability was $\alpha = 0.90$, and CCRP Success reliability was $\alpha = 0.98$. For the six predictor variable reliabilities: (a) IPT Communication was $\alpha = 0.79$, (b) IPT Coordination was $\alpha = 0.81$, (c) IPT Balance of Member Contributions was $\alpha = 0.69$, (d) IPT Mutual Support was $\alpha = 0.89$, (e) IPT Effort was $\alpha = 0.74$, and (f) IPT Cohesion was $\alpha = 0.89$.

The Kolmogorov-Smirnov (K-S) test was employed to test CCRP Success results for normal distribution. The K-S test yielded evidence that CCRP Success data were not normally distributed; therefore, non-parametric tests used were Spearman's correlation coefficient analysis. The Spearman analysis was used to find the correlation between IPT Performance and CCRP Success and the correlation between individual predictor variables and CCRP Success. Ordinal regression was used to determine which, if any, predictor variables were significant.

HGMIL Responses Regarding Team Member Information and Demographics

Item 1 was the respondent agreement to complete the questionnaire. Item 2 concerned team member statuses in which 38 participants responded as military, 20 participants responded as civil service employees, and 13 participants responded as contractor employees. Nine participants claimed a combined service of two or all three categories. All three military branches were represented in item 3. Item 4 eliminated responses for teams with less than three members. Item 5 concerned the type of program planned, and 33 participants listed more than one type of program. Thirty-five respondents were IPT leaders (item 6), and item 7 was used to ensure that members of sub-level teams would not respond. Item 8 and item 9 concerned respondent age during IPT membership and respondent gender, respectively. Eight of the respondents were female.

Program Responses and Respondent Age Brackets

Table 1 provides the programs identified by the respondents, each program's response frequencies, and each program's percentage of total responses. Table 2 provides respondent age during team membership.

Table 1

Program Response Frequency

Program	Frequency	Percentage of Total
Lean	23	18.0
Equipment redesign	21	16.4
Six Sigma	15	11.7
Outsourcing to implement a cost reduction program	15	11.7
Critical Chain	11	8.6
Workload location centralization	11	8.6
Enterprise resource planning system	7	5.5
Just-in-Time	6	4.7
Radio Frequency Identification	5	3.9
Transportation management system	4	3.1
Warehouse management system	4	3.1
Other		
Training software	3	2.3
Toyota Business Process (productivity)	1	0.8
IETM (Electronic training manuals)	1	0.8
Information systems	1	0.8
Totals	128	100

Table 2

Respondent Age Brackets

Age	Number of Respondents	Percentage of Total
Under 25	1	1.25
25-35	16	20.00
36-45	33	41.25
46-55	22	27.50
Over 55	8	10.00
Totals	80	100.00

Correlation between IPT Performance and CCRP Success

The correlation coefficient between IPT Performance and CCRP Success was $r_s = 0.70$, which indicated a high positive correlation between IPT Performance and CCRP Success ($p < 0.01$). The null hypothesis was, therefore, rejected, and the alternative hypothesis was accepted. The following figure is a scatterplot of the correlation.

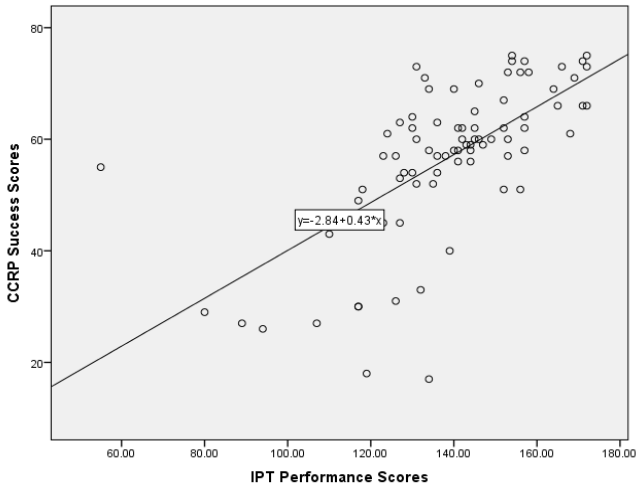

Fig 1. IPT Performance versus CCRP Success.

Predictor Variable Results

IPT Performance consisted of six predictor variables: IPT Communication, IPT Coordination, IPT Balance of Member Contributions, IPT Mutual Support, IPT Effort, and IPT Cohesion.

The correlation coefficient between the IPT Communication performance and CCRP Success was rs = 0.64, which indicated a high positive correlation between IPT Communication and CCRP Success ($p < 0.01$).

The correlation coefficient between the IPT Coordination performance and CCRP Success was rs = 0.57, which indicated a high positive correlation between IPT Coordination performance and CCRP Success ($p < 0.01$).

The correlation coefficient between the IPT Balance of Member Contributions and CCRP Success was rs = 0.51, which indicated a high positive correlation between IPT Balance of Member Contributions and CCRP Success ($p < 0.01$).

The correlation coefficient between IPT Mutual Support and CCRP Success was rs = 0.65, $p < 0.01$, which indicated a high positive correlation between IPT Mutual Support and CCRP Success.

The correlation coefficient between IPT Effort and CCRP Success was rs = 0.36, $p < 0.01$, which indicated a moderate positive correlation between IPT Effort and CCRP Success.

The correlation coefficient between IPT Cohesion and CCRP Success was rs = 0.67, $p < 0.01$, which indicated a high positive correlation between IPT Cohesion and CCRP Success.

Ordinal Regression Analysis

Ordinal regression analysis was performed to determine which of the six predictor variables were significantly predictive of CCRP Success. Although the predictor variables had statistically significant bivariate relationships with the CCRP Success criterion variable in the Spearman's correlation analyses, only three of the six predictor variables had a statistically significant effect on CCRP Success. First, IPT Coordination was significantly predictive of CCRP Success (Estimate = 0.23, Wald = 5.29, p = 0.021). Second, IPT Effort was significantly predictive of CCRP Success (Estimate = -0.40, Wald = 11.10, p = 0.001). Third, IPT Cohesion was significantly predictive of CCRP Success (Estimate = 0.24, Wald = 11.71, p = 0.001). The negative effect of IPT Effort on CCRP Success was unexpected given the positive Spearman correlation between IPT Effort and CCRP Success.

8. Evaluation of the Findings and Recommendations

IPT strengths and weaknesses can be noted by analyzing the means of the IPT Performance items. The relative military IPT strengths (M > 4.00) were: communicating frequently, spontaneously, and directly; sharing program-relevant information; establishing goals; reaching consensus; putting forth great team effort; understanding the importance of being a team member; and the program being important to the team. The relative military IPT weaknesses (M < 3.50) concerned team member conflict resolutions, team members fully pushing the program, and team members making the program their highest priority.

Two reverse scored items' response means scored close to neutral (3). The first concerned much communication being conducted through mediators (M = 2.96). Thirty-four percent (n = 27) of the respondents chose Agree (4) or Strongly Agree (5) that much communication was conducted through mediators. Thirty-five percent (n = 28) of the respondents selected Disagree (2) or Strongly Disagree (1) that much communication was conducted through mediators. From further analyses of the individual results, highly successful, successful, and unsuccessful military IPTs were found to employ mediators; therefore, the results were inconclusive regarding mediator impacts on military IPTs. The current study, however, did not contain findings for the number of mediators employed between the organization and the IPT. A higher number of mediators would result in more biased communication. Information being transmitted through serial reproduction changes to reflect the biases of the people transmitting the information (Xu & Griffin, 2010).

A second reverse scored item concerned conflicting interests regarding subtasks and subgoals (item 23, M = 2.88). Twenty-six respondents (32.5%) chose Agree (4) or Strongly Agree (5) that conflicting interests regarding subtasks and subgoals existed within their IPTs, while 35 respondents (44%) chose either Disagree (2) or Strongly Disagree (1) that such conflicting interests existed. The higher scores appear to be in contradiction with item 21, in which there were clear and comprehensive goals for subtasks within the respondents' IPTs (M = 4.03).

Although the goals for subtasks were clear and comprehensive, the goals also appeared to be in conflict with team member subtask interests in approximately one-third of all the teams. From previous studies, conflicting interests in subgoals and subtasks stemmed from teams with self-efficacious or low-skilled members. Teams containing members with expertise positively predicted a contribution to problem analysis and goal specification, while teams containing self-efficacious team members had a negative predictor of problem analysis and goal specification (Sonnentag & Volmer, 2009). Low expertise members might influence important decisions, as those members do not possess the necessary skills and knowledge (Sonnentag & Volmer, 2009). In addition, teams experiencing problems with goal specifications may contain a high percentage of team members with low skills. When teams include individuals with low job-related skill levels, these individuals are only able to participate under the specific circumstances that conform to their skills, while in other situations they become a burden on their teammates (De La Torres-Ruiz, Aragón-Correa, & Ferrón-Vílchez, 2011).

CCRP Success contained 15 items. Two item response means in CCRP Success scored between Agree (4) and Strongly Agree (5), which were the program can be regarded as successful (item 47, M = 4.01) and team performance advancing the team's image to the program users (item 50, M = 4.03). The lowest item response mean concerned the program requiring little rework (item 54, M = 3.30). This relatively low CCRP item response mean concerning rework appeared to have little effect regarding CCRP implementation, as the item mean program response for the CCRP being within schedule scored relatively high (item 60, M = 3.70). From the CCRP individual response means, 50% of the CCRPs were highly successful, 35% of the CCRPs were successful, and 15% of the CCRPs were unsuccessful.

Ordinal regression analysis was performed in which the six IPT variables were entered as predictors of CCRP Success. IPT Coordination and IPT Cohesion were found to be significant predictors of CCRP Success, while IPT Effort was found to be a negative significant predictor of CCRP Success. Considering all IPT variables together, therefore, the highest CCRP Success scores would be found when IPT Coordination and IPT Cohesion were high and when IPT Effort was low.

The lack of team member effort may be a characteristic of military IPT members with particular experience and expertise in producing a successful CCRP. From the findings, at least two explanations exist for the negative significant predictor, IPT Effort. First, individual team member efforts were not related positively to team performance when team members had previous experience in the current subject matter (Brown & O'Donnell, 2011). For example, team members experienced in computer simulation should exert less effort over those team members who must learn simulation while serving as a team member (Brown & O'Donnell, 2011). In the current study, approximately 79% of the military IPT members were at least 36 years of age, which indicates a possibility of some IPTs in the current study containing the necessary team member experience. Second, if IPT members with experience exert only a small amount of effort in creating successful or highly successful CCRPS, then a military IPT with members who lack experience and expertise, such as self-efficacious members, may have to exert large amounts of effort but still produce a less than successful CCRP. Self-efficacious team members will pose more questions and elicit information because they will assume that their questions are important for the team and not just reflect their own lack of knowledge or understanding (Sonnentag & Volmer, 2009). Additional studies should include findings of whether or not a relationship exists between military IPT member age and military IPT member subject matter experience, and whether or not experienced military IPT members expend small amounts of effort for a resulting negative significant predictor, IPT Effort.

Recommendations for military organizational managers include organizational assessments to determine whether or not their organizational characteristics are conducive to hosting IPTs, and whether or not their organizations contain the necessary number of qualified personnel. The difference between successful and unsuccessful IPT performances may depend on organizational characteristics, and previous studies linked organizational characteristics with team performance. For example, a strong link exists between organizational employee involvement and teamwork performance and effectiveness (Judeh, 2011). Future research should focus on a larger sample to increase the representation of military IPT leaders and members adapting CCRPs for organizational implementation. A qualitative study to observe team interactions for

identifying characteristics of teams and team members is also desired.

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Project Paper

Seismic Location Station for Detection of Unobserved Moving Military Machineries

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Abstract- The main purpose of this paper is to develop a seismic location station that can detect unobserved, moving military objects, and heavy military machineries behind a forest or a mountain at a distance of 1-2 kilometers from the determined location. Seismic location station includes specific 3D seismic detectors based on the very sensible piezoelectric sensors. The proposed piezoelectric detectors are based on the PVDF+$BaTiO_3$+PZT polymer hybrid composite fabricated based on nano sized $BaTiO_3$ (or SiO_2) and micro sized PZT (plumbum zirconate titanate) piezoelectric material. A polyvinylidene fluoride (PVDF) was taken as polymer filler. This study presents the results of the development of seismic wave cells based on 3D seismic detectors. Additionally, a plan is developed and offered for a solution to detect unobserved moving military trucks.

Keywords- Seismic waves, seismic location station, piezoelectric detector, moving military machineries, seismic wave's cell.

1. Introduction

When land forces carry out operations in mountainous or forested regions, they have difficulties detecting unobserved, moving, heavy machineries (tanks or other armored trucks trucks) (Hashimov, 2015; Hashimov, & Bayramov, 2015). As a result, the probability of unexpected attacks increases. Therefore, under conditions of mountainous terrain, it is very important to reveal distant, moving, heavy trucks. Seismic systems can be used to detect the seismic vibration from light and heavy vehicles, trains, and tanks (Anderson et al., 2001; Edwards 2004). Moreover, such seismic systems can be used to detect the acoustic-seismic and hydro acoustic-seismic vibrations from targets such as helicopters, aircrafts, and ships.

Seismic systems have the best ability to detect terrestrial objects among all passive detection systems (Zvejinski, 2005). They have not practically any limitation to detect type of object besides some kind of soil (marshland, drift sand). The high information capacity of seismic signals allows to recognize objects over a vast space (Tubaishat and Madria, 2003; Marchacshinov, 2009 & 2010; Panfilov, 2010).

Many scientific articles are devoted to the detection problem of moving objects by seismic and acoustic methods (Anderson, 2001; Edwards & Robinson, 2004; Zvejinski, 2005; Marchacshinov, 2009 & 2010; Panfilov, 2010; Xin Jin et al., 2012; Alex Pakhomov & Tim Goldburt, 2006; Daniel, 1976; Jinhui Lan et al., 2004).

One article (Xin Jin et al., 2012) is devoted to an automatic acoustic set scanning moving "human activity" on the ground. This paper presents a wavelet-based method for target detection and classification by using unattended ground sensors systems. The proposed method has been validated by the data sets of seismic and passive infrared sensors for target detection and classification, as well as for payload and movement type identification of the targets.

Pakhomov and Goldburt (2006) presented the analyzed acoustic spectrums, obtained from unconventional

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targets: light and heavy vehicles, trains, helicopters, and ships. This paper describes the signal characteristics of such targets and the preliminary experimental data on the corresponding detection range.

Daniel (1976) presented an approach for locating military ground targets with a triangular array of geophones. The target-location system was used in field studies to determine directional angles to military targets, including a 2.5-ton truck, an off-road, and combat engineering vehicle on a tank chassis. The results of the analysis indicate that the location of targets using seismic energy is possible within accuracies of 5^{o} and ranges exceeding 450 m. (Daniel H., 1976).

Jinhui Lan et al. (2004) presented a novel method of target classification by means of a micro accelerometer. The seismic signals from moving vehicle targets are detected by a micro accelerometer, and targets are automatically recognized by the advanced signal processing method.

We know the general physical idea of moving target detection and propagation acoustic waves. Moving targets exert a time changing force at the earth's surface. The soil starts vibrating and then the seismic sensor converts such vibrations into electrical signals. For moving targets in the air or in the water (helicopters and aircraft, ships, or submarines), there are more complicated physical processes. Moving targets produce acoustic waves in their corresponding medium. After propagation, these waves exert a force on the earth's surface. Then, the soil vibrates and the seismic sensor converts such vibrations into an electrical signal.

This paper is devoted to the development of a seismic location station that can detect unobserved, moving military objects. A seismic location station is developed based on 3D seismic triangular detectors and can detect heavy (P > 2 ton), moving, unobserved (behind a forested area or mountain) combat vehicles at a distance of 1- 2 kilometres. These 3D sets can detect the space location, speed, and trajectory moving target with space and angular accuracies of several meters and < 3^{o}, respectively. The seismic detector we have proposed to use was a high sensitivity, piezoelectric detector using PVDF+$BaTiO_3$+PZT polymer hybrid piezoelectric composites based on the nano sized $BaTiO_3$, SiO_2 and micro sized PZT (plumbum zirconate titanate) piezoelectric transducer. Polyvinylidene fluoride (PVDF) was used as a polymer filler (Kerimov et al. 2011; Kurbanov et al., 2013).

2. Seismic Waves Cell

The seismic location station is a passive set and radio electronic equipment cannot detect it. Using software in real time, the receiving signals from the seismic detectors were processed, and the following tasks were solved (Marchacshinov, 2009 & 2010):

- Detection of moving, ground objects;
- Filtration of false signals (noise) and classification of detected moving objects (tank or combat vehicle);
- Determination of coordinates and trajectories of targets on the move.

The disturbance of aircraft or helicopters by rain or wind can be seismic noise. Seismic wave detection becomes worse in friable soil and for deep snow cover. However, for mountainous regions like Azerbaijan, these factors are not considerable.

The developed piezoelectric detector is one of the main parts of the seismic location station (Fig. 1).

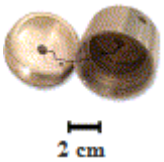

Fig. 1. Piezoelectric detector.

This piezoelectric detector can receive very weak seismic waves and converts them to electrical signals. Then, the signals are amplified, filtered by a special electrical circuit, and transmitted to a processing block. A piezoelectric detector was fabricated using polymer (polyvinylidene fluoride) PVDF+$BaTiO_3$+PZT hybrid piezoelectric composites on the basis of nano sized $BaTiO_3$ (or SiO_2) and micro sized PZT piezomaterials (Kerimov et al., 2011; Kurbanov 2013). This piezoelectric detector has very high acoustoelectric characteristics (Fig.2).

There is a frequency dependence of the amplitude of the output signal of the piezoelectric detector per unit of acoustic wave pressure (acoustic electric sensitivity), as seen in Fig.2. There is a sufficiently high and stable acoustic electric sensitivity of piezoelectric detectors in the frequency range of surface seismic waves (0.005-0.2 кHz). In the range of low frequency (1÷10) Hz, subsurface seismic vibrations are weak as a result of climate factors.

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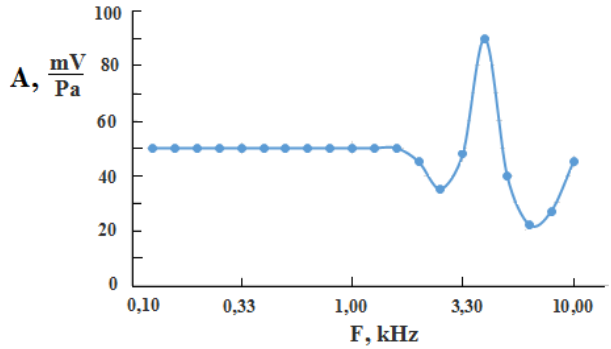

Fig. 2. Acoustoelectric characteristics of the piezoelectric detector.

Fig. 3 shows the developed construction of a single-coordinate piezoelectric detector PD.

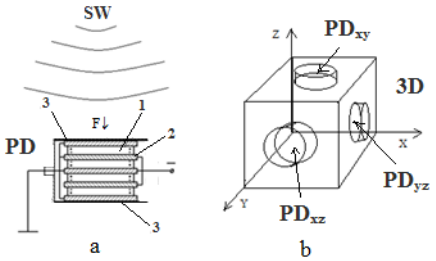

Fig. 3. Design of a single-dimensional PD (a) and 3D-dimensional (b) piezoelectric detectors: 1–piezoelectric plates; 2–foil layers, 3– insulating layers; PD_{XY}, PD_{XZ} and PD_{YZ} are piezoelements allocated on the *XY*, *XZ*, and *YZ* planes, correspondingly; SW- seismic wave.

Seismic waves impact the surface of the PD, pressures on piezoelectric plates, and, as result, an electric signal is generated. To precisely analyze the space location of the seismic wave source, three single-coordinate PD are collected in integrated construction, which is the 3D detector. Here, three single-coordinate piezoelectric detectors PD_{xy}, PD_{xz}, and PD_{yz} are located on three orthogonally related planes XY, XZ, and YZ (sides of the cube) (Fig. 3b).

Then, three 3D detectors are collected in one cell-receiver construction SWC (Seismic Waves Cell) (Fig. 4), information recorded by three 3D detectors is sufficient to determine the location of object.

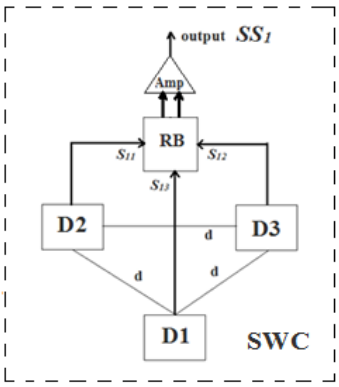

Fig. 4. The chart of the Seismic Waves Cell (SWC). D1, D2, D3 – 3D seismic detectors; RB - receiving box; Amp – amplifier; d – distance between detectors (base of SWC).

Mounted in the subsurface soil layer at a depth of 20-50 cm, the sensitive elements of 3D detectors convert seismic vibrations into electric signals, which are transferred to the input of the registration block RB. The distance between the 3D detectors in cell (a base) is d = 7 m. The output signals from the 3D detector can be expressed as $S = f(X,Y,Z)$. Output signals from the three 3D detectors in one cell can be expressed as:

$$S_1 = f(X_1, Y_1, Z_1)$$
$$S_2 = f(X_2, Y_2, Z_2)$$
$$S_3 = f(X_3, Y_3, Z_3)$$

These signals input into a registration block RB, are amplified and form output signals SS_i:

$$SS_i = F(S_{i1}, S_{i2}, S_{i3})$$

To locate a target, the following scheme was employed: the location of target is determined by the directional angles to a target from two spatially separated triangular cells (Fig. 5). The point of intersection of the two lines defined by the directional angles is the estimated location of the target. Triangulation determines the two coordinates required for the location. The directional angles are determined from the data received at the reference array.

In the current case, we have *n* mounted SWC which reveals a high coordinate accuracy of the target location.

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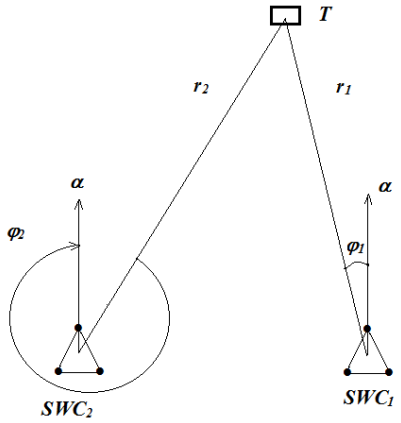

Fig. 5. The determination of the target location by triangulation: r_1 and r_2 are distances to target T; α is a reference direction; φ_1 and φ_2 are directional angles.

3. Seismic Location Station

$SS_1, SS_2, \ldots SS_n$ signals from n SWC cells of the seismic location station input to analyzing block AB (Fig. 6). In addition, block AB analysis *ASS* signals from the acoustic system AS in anticoincidence regime that eliminates false signals from aircraft or helicopters (fig. 7). Depending on a given task, climate and environmental conditions, a number of SWC (n), the width of the seismic location station (a base) can be (50-100)m.

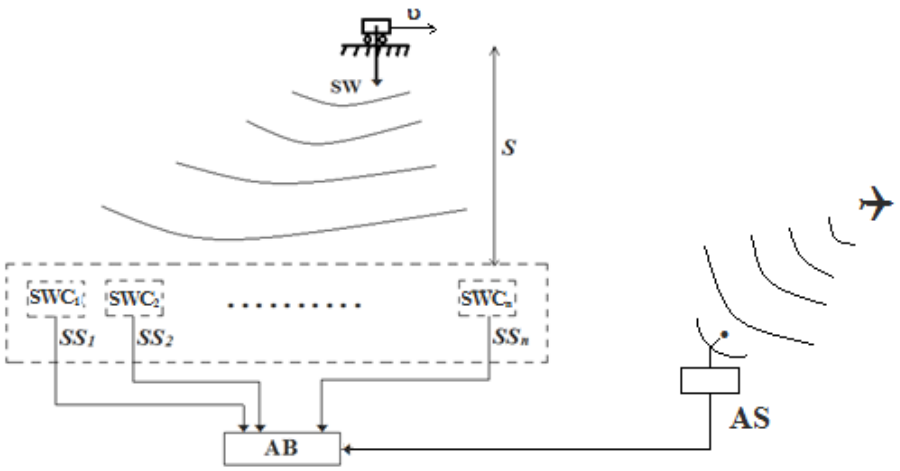

Fig. 6. Seismic location station SLS. SWC_i - seismic waves cells; SS_i – output signals from SW_i; SW – seismic waves from moving truck; υ - velocity of truck; S – distance to moving truck-target; AB - analyzing block; AS-acoustic system.

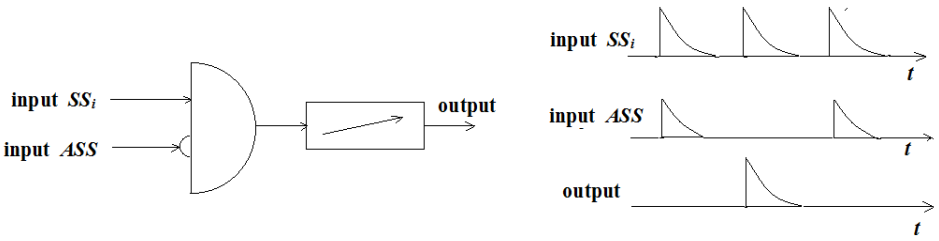

Fig. 7. Anticoincidence circuit.

The geometric configuration of the seismic location station SLS was developed to the greatest extent possible to increase its sensitivity to exactly locate remote moving objects, define the path trajectory, and speed of movement.

To classify discovered moving objects, SS_i signals in the AB block are compared with calibrating signals obtained from the database. These calibrating signals are obtained for various kind of moving, heavy military trucks (tanks, combat vehicles) at various meteorology conditions (hot or cold weather, rain, snow) for various soils, and for various distances (300 - 2000 m). The speed of seismic wave spread υ depends on the properties of the soil and weather conditions and ranges from 90 to 250 m/sec. Considering the mountainous highlands, we have

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υ=220 m/sec. Therefore, to increase the measurement accuracy of coordinates, speed, trajectory, and type of target the next chain of solutions was employed very sensitivity piezoelectric sensors (Fig. 8)

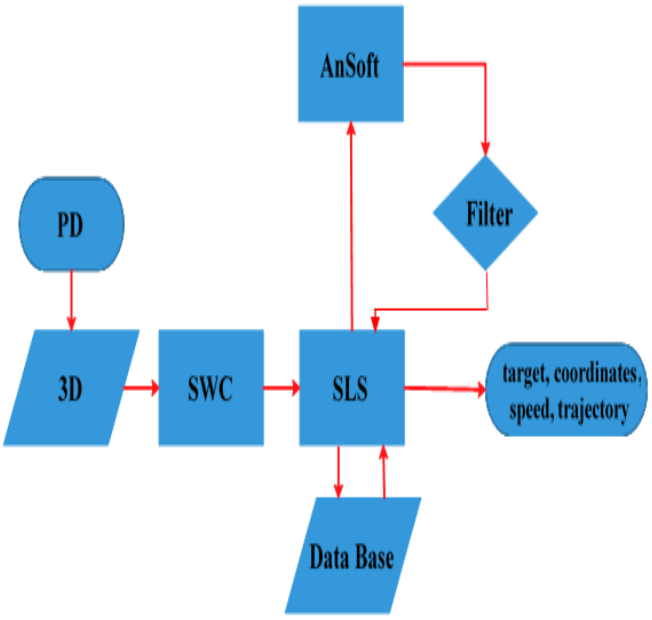

Fig. 8. Solution plan to detect unobserved moving military trucks.

SWC – special geometric configuration of seismic location station
SLS – special analyzing software
AnSoft – filtration false signals
Filter – database of seismic signals of moving heavy trucks
Data Base. This solution set provides the efficiency of the seismic station.
PD and three-coordinated forms
3D – triangular configuration of seismic detectors

4. Conclusion

This paper presents the results of the development of a seismic location station with special geometry. The development of seismic wave cells based on the 3D seismic detectors is presented. A solution plan to detect unobserved, moving military trucks is offered.

It can detect coordinates, speed, trajectory, and type of unobserved, moving, heavy military trucks at a distance of 1-2 kilometers from the station. The seismic station has been developed based on 3D seismic detectors. Seismic detectors are high sensible piezoelectric transducers including polymer hybrid piezoelectric PVDF+$BaTiO_3$+PZT composites based on nano sized $BaTiO_3$, SiO_2 and micro sized PZT piezomaterials. Polyvinylidene fluoride is used as a polymer filler.

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Report

Security-Welfare Dilemma from a Strategic Management Perspective: The Albanian Case

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Abstract- Relations between security expenditures and welfare is a frequently questioned and discussed subject. However, the subject has not been discussed from a strategic management perspective. The common perception is that there is and there must be a balance between two expenditures and increasing one of these effects the other in opposite direction. As it is called a security-welfare dilemma, the aim of this paper is to focus on this dilemma in the Albanian case, and indicate solutions with the aid of strategic management. The selected Albania case is a concrete and recognized example demonstrating Balkan differentialism. An attempt is made to answer to question: "What if Albania implemented a reasonable and balanced policy of these two expenditures?" The results demonstrate that as a unique example (a part of Balkans but always have different results), Albania is generally on the opposite edges of these expenditures and has not a balance between two that is showing lack of strategic management perspective.

Keywords- Strategic Management, Defence, Security, Welfare, Albania, Security expenditure.

1. Introduction

Strategic management is a process defining an organization's purpose of presence, objectives, and ways to achieve the defined objectives (Barry, 1986). In other words, it is a process telling organizations how to achieve goals, and compete with the rivaliries/enemies (Aktan, 2008). Every nation/government can be thought of as an organization and this way of thinking will help to solve problems.

On the other hand, defence is one of the basic responsibilities of governments and it has two main objectives. First, the deterrence of any aggression or will against the country; second if aggression is realized, defend the country. Both, deterrence and defense require expenditures of the military in terms of training, vehicles, equipment starting from peace time. Public expenditures allocated for these military duties are defined as the defense budget. When war begins, it is the amount of expenditures made during peacetime that defines the type, prevalence, and intensity of war (Aslan, 1998).

Security is generally a synonym with defense and in this article will be use as a common term. It consists of eliminating all kind of threats and instability, and establishing continuity of governments (Değer & Sen, 1995). In other words, and in a general sense, security consists of eliminating internal and external threats and prevents social-political instability (Değer, & Sen, 1995). Security is effected by five factors; military, political, economic, social, and environmental (Dülger, 2004).

Is there a relationship between security expenditures and a country's economy? Which one affects the other? It is possible to increase the questions, but it is better to put an end to questions and provide a clear view from an economic perspective.

One of the main interests of economists dealing with security expenditures is the relationship between security expenditures and economic growth. Even if it is declared that there is a strong relationship between

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these two factors, there are different results about the effects and nature of the relationship (Giray, 2004). How much money must be used for security? In other words, what is the optimal amount for security expenditures for a nation? The answer to this question is important for all countries because mistakes and incorrect assessments will have collateral effects now and in the future of the nation. If too much money is allocated for security, this will affect economic growth. Too little expenditures will threaten growth through instability and causing chaos (Değer & Sen, 1995). Therefore, the dilemma faced with this expenditure balance is called the security-welfare dilemma and it is thought of like two sides of a scale. It is loaded on side and then other side will be affected in the opposite direction. Therefore, it is perceived that when too much money is transferred to security, this will mean a cut from welfare expenditures and vice versa.

The Balkans has special circumstances based on geography. Any approach having positive results in any other part of the world can result in opposite effects in this geography. A security and welfare approach also must be considered in the same way. Especially in the last 100 years, this geography has been full of war and blood. The Balkans, because of being an area of interest of different countries and mixtures of cultures, has had many problems establishing a nation-state and national army.

Albania is a part of the Balkan region but has always had specific conditions. In some cases it has the exact Balkan's regional characteristics while in other cases just opposite. After becoming an independent country in 1912 and until having current democracy, it had different tendencies, management styles, and a history full of turbulence. Therefore, being a good example and depicting some realities of the Balkan region is one perspective and having special characteristics is another perspective, Albania serves as a good example for this research.

2. Theoretical Framework

a. Security-Welfare Balance until the 20th Century

Throughout history, government-military relations have always been deep and multidimensional. It is obvious that during the Middle Ages, this relationship was military-based. We cannot distinguish both the Roman Empire's vision of democracy and the Ottoman's consultation-based government management from this perspective. We can summarize this period's military-government relations and security-welfare balance as a ***victory-booty-wealth*** equation. Governments that were not able to sustain this cycle could not be able to continue its presence. Ottoman Empire is a concrete example. Victories until the 18th century increased their wealth. However, in the 19th century, victories resulted in impoverishment of the government. Even if there are many theories about the collapse of the Roman Empire, Peter Heather's theory is important from our perspective. Heather implies that:

> *It is the increasing power of Iran's Sasani Empire (226-651) that initiated the demolition of the Roman system. The Roman Empire was forced to allocate the first 25% of its military power to the steadily increasing Sasani threat, then this amount increased to 40 percent. ……. Romans could be able to overcome the threat in 50 years but the burden was too much. In order to finance the army that was tasked with this conflict, the government increased the tax burden to western cities. As a result, its sources of income were depleted. Since income decreased, public investment and producing stopped." (*www.sabah.com.tr/*, Retrieved on 05 September 2015).*

At the end of the 18th century, the world had a new vision with the effects of Industrial Revolution. With the new age and vision, the victory-booty-welfare paradigm changed. The invention of new energy sources and the presence of these sources in different areas of world forced governments to implement new methods. The increasing power of law and democracy made land invasion difficult, resulting with the use of indirect methods, and the replacement of soft-power instead of hard-power. Therefore, new changes obliged governments to have more professional budgets and more planned expenditures.

Another important point is the increasing expectations of people and society. With the effect of TV and media, societies observed other people's more luxurious and wealthy life style resulting with increased expectations. Therefore, the 20th century's inventions also affected people's welfare expectations.

b. Security and Economy

The visions and perceptions of countries about security differ, and this difference affects security expenditures, as well. For example, geopolitical situations and historical ties are important factors. In the

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case of Israel, security expenditures are among the most important public expenditure group. The defense industry has an important and basic role for the development of the country's technological and industrial capacity. In 2014, three of the 100 biggest defense industry companies of world belong to Israel (www.sipri.org/, Retrieved on 26 September 2015). It is also a major player in the global arms market and is the 8th largest arms exporter in the world as of 2014 (http://armstrade.sipri.org/, Retrieved on 26 September 2015). Some other factors that affect the perceptions about security are: inland factors (Peterson & Tiebout, 1964), the nation's political regime (Looney, 1994), total population at risk, possibility of attack, level and allocation of national income, age profile, and level and quality of life that can be affected by cultural differences (Aslan, 1998).

Sources allocated for security expenditures consist of an important portion of both total public expenditures and national income and these sources took from different areas that can be very important for nation's growth. From this perspective, it is appropriate to mention that security expenditures are to the detriment of a nation's economic growth. However, on the opposite side, security is a duty that cannot be given up in order to sustain nation's presence and independence. The second perspective is supported with Adam Smith's idea: "As defence, however, is of much more importance than opulence" (Smith, 1776). That can be translated as: "if you don't have a country you will not need money." In other words, security is a must in order to establish welfare in the country.

A popular assumption by researchers and policymakers alike is that the influence of security spending on economic growth is negative. However, the empirical evidence on the security expenditure-growth relationship is decidedly ambiguous (Castillo et al., 2001). There are many studies claiming that security expenditures support economic growth and progress in different ways. Twenty-nine studies investigated the relationship between security expenditures and economic growth between 1980 and 1995. Some of them depict that security expenditures have no effect on growth; some assert a positive effect, while some declare a negative effect (Ram, 1995).

In a study of 44 developing economies, Benoit (1973), found no evidence that security spending has an adverse effect on growth. In fact, even after controlling for reductions in foreign investment and aid as a result of military spending, the correlation between military expenditures and economic growth remained positive (Castillo et al., 2001). Another finding of Benoit was that countries with a high defence budget generally have the largest growth rate, while the smallest budget countries have the smallest growth rate (Ram, 1995). Some studies depict that the effects of defence expenditures on growth can change according to the short and long term. For example, the effect can be zero, even negative, in the short term, while positive in long term (Looney, 1994). According to Smith (1989), in an examination of British military expenditures post-1945, he found that military expenditures are a positive function of economic performance and the relative price of military and non-military goods and security variables based on threat appreciation and military alliances (Castillo et al., 2001). More recently, a study by Babin (1986) examined 88 developing economies from 1965 to 1981. He found a consistently positive relationship and concluded that military stability, which requires military capability, is an important precondition for economic advancement in the Third World (Castillo et al., 2001). Finally, according to Chowdhury (1991) and Kusi (1994), in both studies, the results suggest that the relationship between defense spending and economic growth cannot be generalized across countries. However, where a relationship does appear to exist, there is slightly more evidence to suggest that increases in military expenditures anticipate declines in economic growth, while increases in economic growth anticipate increases in military expenditures (Castillo et al., 2001).

Table 1. Comparison of Causality Results, (Castillo et al., 2001; Chowdhury, 1991; Kusi 1994)

Sample and Findings	Chowdhury	Kusi
Number of Countries	55	77
Number (percent) of countries with result		
No statistically significant causal relationship	30 (55%)	62 (80%)
Military expenditures reduced economic growth	15 (27%)	3 (4%)
Military expenditures increased economic growth	0	4 (5%)
Economic growth reduced military expenditures	1 (2%)	1(1%)
Economic growth increased military expenditures	9 (16%)	6 (8%)

On this point, a perspective from the point of budget planning will help to understand the relationship between the security-welfare balances. According to Korkmazyürek (2009), new defense planning consists of four periods:

- Static Planning (Between the two World Wars),
- Threat Based Planning (Cold War Period),
- Capability-Based Planning (Post-Cold War Period - Until 9/11) and,
- Ability Based Planning (Post 9/11 2001).

Static Planning *(Between the two World Wars)*

Static Planning is the concept that a threat is well defined and known, there is no uncertainty and the threat is linear and symmetric.

World War I is a breaking point in terms of security and military perceptions. Until World War I, it was the empires that were filling the power balance in the world. However, with World War I, power transferred to international actors resulting with a total war. World War I caused a great polarization and resulted in huge damage. It demolished the international balance and resulted in some nation's loss of economic sources and honour. The new circumstances were filled with hatred and humiliation triggered nationalistic senses, resulting in a new arms race as the beginning of a new crisis. In this period, the balance was obviously on the side of security. Germany led the militarization, and the arms race is the main characteristic of the period. The work of Castillo et al. (2001) depicts a view about the motives of five big powers' military spending from 1870 to 1939. When we focus on 1919-1939, it is obvious that "fear" is the common point for all countries. Additionally, "ambition" to normalize broken honour and become a super power again in the region for Germany is noticed.

Table 2. Power Military Spending Relation (Castillo et al., 2001)

Period	***France***	***Germany***	***Japan***	***Russia***	***US***
1870-1890	*Ambition*	*Fear*	*Fear*	*Ambition*	*Ambition*
1891-1913	*Fear*	*Ambition, fear and legitimacy*	*Ambition and fear*	*Ambition and fear*	*Ambition and fear*
1919-1939	*Fear*	*Ambition and fear*	*Ambition, fear and legitimacy*	*Fear*	*Fear*

Threat Based Planning *(Cold War Period)*

Threat Based Planning is the concept integrating different forces and establishing collective action. In this concept, the main idea is to focus on the idea of "*what can the enemy do*" and try to find an optimal solution to eliminate this threat. The model is characterized with *capabilities*. Therefore, this model focuses on how the enemy can fight (which capabilities it will use) instead of who the enemy is and where there can be a conflict (Topcu, 2010).

This period is the Cold War period. The world has divided into two poles and the increased intensity of the arms race has an important effect on the security-welfare balance. It is clear that in this period, the balance in security-welfare was on the security side. Therefore, in the polarized world, the main motive was the threat from the other side. Additionally, tension was steadily increasing with the effect of the nuclear race. For welfare, the effects of this race in developed countries was limited while the effect on non-developed and third world countries was deep and negative. During this period, one side improved its welfare with the help of war and a weapons economy, while the other side could not endure the velocity of the race anymore and collapsed in 1989. Neutral and third world countries were the most negatively affected countries by the race. Albania was one of them. At the end of the Cold War, the result was one side benefitting from using billions of dollars for defense and security as being the only superpower of the world, while the other side gave up from armament race. To summarize, at the end of the Cold War, the result was:

-Ideas expressed as the "end of history" (Fukuyama, 1992),

-East Block that gave up from armament race,

demolished and fragmented countries,

-Neutral and third world countries faced great problems for welfare.

During this period, great losses occurred to the disadvantage of welfare. As being the ultimate ratio in human being's political activities (Fukuyama, 2007), ***power*** emerged. It was the political choices and power struggle that defined the arms race (more than real tension). For this reason, even if trillions of dollars are spent on International Ballistic Missiles (ICBM) they are never used (Dunnigan, 1996).

Between 1980 and 1998, the two-sided polarization was replaced by a multi-sided polarization. In this period, an important decrease occurred in security expenditures--mostly in developing countries, led by the Middle East, and a lesser extent in South Asia and North Africa. It was the financial obligations that forced governments to arrange public expenditures' priorities (Looney, 1994). While these countries were decreasing defense expenditures, some others (US, Russia, China, EU countries, India, Pakistan, Israel, Syria, Iran, and Iraq) still had large defense expenditures.

Capability-Based Planning (Post-Cold War Period-Until 9/11)

After the Cold War period, the threat changed and the "***asymmetric threat***" concept rose. New technologies adapted immediately to the military and concluded with the use of smaller and light-equipped forces for use in longer and flexible missions (Topçu, 2010). These changes caused improvements in "*Capacity Based Planning*" that is to establish capacity packages in order to use the right combination of capacities at the right time and place (Korkmazyürek, 2009). The main idea of this conceptual change was to see security not as a result of capacities, but a dynamic balance between threats and capacities. According to the concept, ensuring a decrease in the threat was also a part of security politics as much as defense planning. The main idea with the theory was "security cooperation **with** others but not **against** others" (Nelson, 2001).

In this period, we observe a dramatic decrease in defense expenditures, parallel to political and strategic vision changes. As Dunne (2000) emphasizes:

> *With the end of the Cold War the changed strategic environment has presented an opportunity to reduce global military spending. In the developed world the end of the super-power arms race has, indeed, led to marked cuts in military spending, while in the third world the removal of superpower involvement in regional conflicts has reduced tensions, military and military-related aid, and the scale of conflicts. Although this has led to some reductions in military spending in the developing countries the situation is complex. There are still some countries increasing their expenditures, mainly in response to local insecurities and local arms races, but also encouraged by the push for arms exports by the developed countries. Weapons have become cheaper in the increasingly competitive world market and the world remains a very dangerous place with many regional and civil conflicts.*

Even if the arms race has finished, some countries have not given up on the race. One reason for the continuing arms race was the effects of regional conflicts and fears remaining from the Cold War period, while the second reason was the political incentives. Political figures that produce enemies in order to implement their will are a common example and in this case the *will* is the arms race. Lastly, the effect of the weapons industry and its power in politics must be emphasized.

Comparatively, a decrease in the arms race is observed, but reality is that expenditures did not affect developed countries because of the magnitude of the economy, while on the other side, small countries were again in real trouble. Since investment is not implemented for health and education, the welfare level continued to decrease. Certainly, the belief that reducing security spending will lead to a "peace dividend," as the economic benefit of re-allocating security expenditures to other uses has been termed is not accepted by all. Some people have argued that cuts in security expenditures are more likely to result in a "*peace penalty*" because of the costs of adjustment. The experience of the developed economies is rather salutary, as they have generally failed to benefit economically from cuts in their security expenditures (Dunne, & Willett, 1992). After a break, security expenditures began to increase again after 1998. The increase between 1998 and 2001 was around 7%. This increase was a result of the trend in economic, political, and technological changes in the Middle East, Eastern Europe, North America, and East Asia (Başar & Künü, 2012).

Ability Based Planning *(Post 9/11 2001)*

9/11 was the beginning of the fourth period. With the 9/11 attack, threat assessment was defined again. The world focused on terrorism and asymmetric threats (Topçu, 2010). The use of the phrase "*war on terrorism,*" first used by George Bush on September 20, 2001 (www.theguardian.com/, *Retrieved on 05 September 2015)* and new type of combat and security perception were defined. From this point on, there was only one superpower leading the entire world in order to fight with terrorism. The new type consisted of much more flexible techniques and equipment and was meaning to improve abilities to fight with new threat, terrorism. In the post-9/11 era, special-operations forces have often conducted direct-action missions in support of conventional forces (Bilgin & Goztepe, 2013), meaning that usage of special forces gained importance. And it was also an opportunity to consume arms waiting in stocks and make the economy wheel turn again.

3. The Albanian Case

As it was mentioned before, Albania is a part of Balkan region but always has specific conditions. After gaining its independence on November 28, 1912, on December 4, 1912 the National Army was established (www.aaf.mil.al/, Retrieved on 28 August 2015). When discussing security in the Albanian case, we must understand the army in particular. After gaining independence, for a long time, the main topic of the country was whether establishing an army is the right decision or not. From this perspective, the first period of the Albanian security-welfare case consists much more about establishing a nation and then an army. During this period, it is difficult to have a clear understanding about the balance. We sometimes observe security expenditures to be too limited. After a while, in order to fill the gap, then amount increases too much. Therefore, it is better to focus on the details following independence.

During the period of 1914-1918, the main Albanian force was the gendarmerie and a few military forces, organized into a regiment to protect the country's southern borders. We may consider a real military organization and the Albanian regular army only in the subsequent years after the historic Congress of Lushnja in January 1920 (Hasani, 2012). During this time, the basic argument was "*…..the army is that power that ensures the vitality of the state. Therefore, it is requested to establish the Ministry of War*" (Hasani, 2012). In 1921, a force not exceeding 7000 people was established. The army budget was 6,500,000 golden frangs (Hasani, 2012).

During 1925-1928, the military organization was based on the mercenary system, in addition to the previous traditional system (military group bases). In 1925, establishing an army was still on the agenda. In the first Albanian Republic, according to Article 111 of the statute *"… military service is mandatory for all Albanian citizens" (*Hasani, 2012), arguments were still valid.

In 1927, the mercenary system collapsed and the influence of Italian military organizers to build an army of a regular kind began. During the Albanian Monarchy between 1928 and 1939, a regular army structure was established. In 1931, the Army was very professional and a chain of command was established. As a result of these arrangements, from 1931 to 1932, the Army budget had a large increase by reaching an unprecedented figure to that time: 11,499 million gold francs. Together with that of gendarmerie, it reached 50% of the total state budget. This figure was the highest quote in the history of army powers from 1912 to 1939 (Hasani, 2012). In the ten-year period from 1928 to1939, the Army Powers of the Albanian Kingdom and particularly the Army were enriched and improved by other elements, increasingly giving it the image of a regular army, similar to armies of other countries (Hasani, 2012). Obviously during this time, the balance between security-welfare was on the security side.

Everything that the Albanian state and its Armed Forces had achieved before the start of World War II faded on the day of the fascist aggression against to country on April 7, 1939. Albania's neophyte army proved unable to stop the Italian invasion of Albania in 1939. Zog's rule came to an end in April 1939, when Mussolini's armies invaded and annexed Albania. The Nazis soon took over as the occupying force (Danopoulos, & Skandalis, 2011). The state became non-existent and therefore, its Armed Forces, as well. Under these circumstances, the new Armed Forces arose, which belonged to different political groups of the time and which faced the invaders (www.aaf.mil.al/, Retrieved on 9 September 2015).

New army consisted of volunteers and established against to invaders. As called National Liberation Anti-Fascist Volunteer Army, this Army created 24 brigades, eight divisions, and three army corps, approximately

45,000 soldiers and it is considered one of the most successful armies since 1912. In November 1944, together with the territorial forces, it reached 70,000 soldiers. This number represented seven percent of the Albanian population in that period (www.aaf.mil.al/, Retrieved on 9 September 2015).

Second Period

Second period is more clear and it is possible to label Albania's second period as "*the country in a world of its own*" and "*allocated all its energy and money to security.*"

Following World War II, Enver Hoxha came to power. The Albanian Politic Leadership (APL) came to power through force. As such, the party and army had a very close, symbiotic relationship that continued in the years following the coming to power (Danopoulos & Skandalis, 2011). According to Amos Perlmutter and William LeoGrande, "symbiotic relationships are characterized by low levels of differentiation between military and civilian elites, and the circulation of elites between military and non-military posts.'' (Perlmutter & Leogrande, 1982). Approximately half of the 100-year independence of Albania consisted of the Cold War period and we observe that during Cold War period Enver Hoxha's regime prepared the whole country as a battleground. The perception and ideology of the country's regime was consisting of high nationalistic vision, a country surrounded with enemies, a strong nation that can protect the country in any case, and a management style full of mottos. However, like their Vietnamese brothers in Marxism/Leninism, the Hoxha group was inspired by strong nationalist sentiments. This strong nationalistic sentiment was the backbone of Hoxha's regime and security perspective (Pano, 1968).

Albania-Russia relations began in 1948. And Albania was a member of the Warsaw Pact from 1950 to 1968 and the army was equipped with weapons and equipment from the Soviet Union (http://www.aaf.mil.al/, Retrieved on 9 September 2015). The Tirana–Moscow honeymoon lasted for approximately twelve years (1948–1960). However, the nationalistic and ideologically rigid Hoxha regime soon found itself in disagreement with the Soviet Union (Prifti, 1978). The break with Moscow also served to reorient Albania's foreign policy, paving the way for the country's xenophobic leaders to turn their eyes toward Mao's China. The Albanian-Chinese love affair lasted longer (1961–1978). The Chinese departure heralded a period of self-reliance and dependence of its "own armed forces and military capability." (Prifti, 1978).

After thirty years (1948-1978) with Russia and China, it is difficult to have a clear view about the amount of money transferred to security from both countries. Missing official documents makes it difficult again to determine what percentage of GDP was allocated to security. Another reality is during the Cold War, in the 1970s-1980s, the Armed Forces had a large numerical increase, reaching 61,000 active troops, 26,000 reserve troops, and a large number of volunteer troops. In the late 1980s, the Army had 22 divisions that constituted three fronts. Based on the defence concept of each square meter, the army was deployed to 2,200 points across the whole country, and fortification became a separate goal. For the first time in world military history, the free military schools were opened in Albania (www.aaf.mil.al/, Retrieved on 9 September 2015) As part of the idea that "*every member of state is a soldier,*" these schools trained people.

After Hoxha's period general situation was:

> *The APL's policies wreaked havoc on the nation's military. The country's poor and deteriorating economy and Hoxha's decree against borrowing made life rather difficult for Albania's 84,000-strong military. Yet Tirana had the dubious distinction of having the world's highest percentage (14%) of men in uniform in proportion to the population. Impoverishment and substandard living conditions eventually led to ''a serious breakdown of discipline at many levels, creating problems of morale and affecting the operational inefficiency of the army.'' Reports also surfaced about ''troops resisting officers, refusing orders, and being generally indifferent to army regulations.'' (Prifti, 1978).*

It is obvious that during this period, the security-welfare balance leaned toward security. As mentioned above, even if we have insufficient and concrete economic numbers belonging to this period, no one can deny that most of the country's sources allocated for security additionally the amount came from Russia and China. In the end, the result of Hoxha and Cold War period was interestingly but not surprisingly disaster for both security and welfare. At the end of Cold War and the following years, Albania was the poorest country of Europe. There still was an army, but it did not have the capacity to fight.

Third Period

After having a high profile and using most of the GDP during Enver Hoxha's time, the security side confronted the opposite behaviour of democracy. Meeting with democracy and angry with the soldiers of the Cold War, new democrat leaders aimed to decrease the power of the army and cut security expenditures. President Berisha's government proclaimed its desire to set Albania on a democratic course, the economy was largely privatized, the country re-joined the community of nations, a multiparty system was allowed to emerge, and the president and his government laboured to improve Europe's poorest economy (Danopoulos & Skandalis, 2011).

Even if after Cold War, the general atmosphere in Balkans was uneasy and Albanian politicians were decisive and did not give up their objectives. The new government proceeded to slash the defense budget almost by half and to reduce the size of the armed forces considerably. (Danopoulos & Skandalis, 2011). So the balance was shifted to the welfare side. In the following years to eliminate the weakness in security risks Albanian government established strong relations with United States. As Danopoulos & Skandalis emphasized (2011) "following years the American military and other advisers occupied various government agencies, including the Ministry of Defense and their advice weighed heavily on issues relating to Albania's security policy and the military". Following steps made by politicians was "to exclude soldiers from decision-making process." (Lane, 1998). The government pursued its efforts without consulting the military or other elements of society. It purged the officer corps, slashed the defense budget, and sought to impose top-down professionalization on Albania's armed forces (Danapoulos & Skandalis, 2011). By the end of 1995, the Albanian army was "*an army in name only*.'' (Lane, 1998).

In 1997, disaster happened. With the 1997 implosion (called a pyramid scheme and addressing an economic crisis), the army disappeared. Therefore, efforts to exclude the military from decision processes and increase welfare failed. First, the desire of the population to fill the welfare gap immediately triggered a crisis, and then the lack of a reaction from the army completed the collapse. When the crises began, the army did not try to stop the stampede and the crisis grew resulting in a decline in internal security. At the beginning of crisis, the Albanian army disintegrated and did not and could not heed the President's call to quell the popular uprising in March 1997 (Danopoulos & Skandalis, 2011). As Adam Smith emphasized: "Security is more important than wealth" (www.ifaarchive.com/ Retrieved on 12 September 2015).

The reasons behind the collapse were: first, the fight between old and new military management styles (Limaj, 2014), which accelerated the collapse; second, a lack of motivation in the military, as Lane emphasized, was "the failure of the leadership to properly feed, pay, clothe, and generally care for the army.'' (Lane, 1998).

Another motive of this period was an attempt to become a NATO member. In 1992, Albania publicly declared its aspiration to join NATO, which was followed by concrete steps in this regard. Tirana established a close relationship with Turkey, which caused much consternation in Athens and Belgrade (Danopoulos & Skandalis, 2011). Thus, in 1994, it signed the document within the framework of the PfP (Partnership for Peace) and in June 1995, Albania officially became part of the PfP initiative. In 1999, for the first time it prepared the Membership Action Plan (MAP). Although in 1997, as a result of the crisis, the armed forces were the most failed force. Within a relatively short time, they rebuilt and became a worthy contributor to security and peace in the region and beyond (www.aaf.mil.al/, Retrieved on 10 September 2015). This period for Albania is unclear. However, the 1997 crisis made everything more complex. When the country was entering the fourth period, the security-welfare balance did not exist. Security collapsed resulting in NATO's ALBA operation and welfare collapsed as well, resulting in millions of dollars of Albanians being stolen by bankers.

Fourth Period

As the world was renewing its vision about terror and effects on security, the perception in Albania was still different. It was attempting to minimize and decrease the effects of the 1997 crisis and trying to restructure the constitution, including the army. The effects of 9/11 on Albania were the increasing power of the United States in terms of intelligence and police. Between the years 1992 and 2009, military activities based on bilateral relations provided an opportunity for the country to prepare for NATO membership. In 2009, NATO membership was a breaking point for the country. Before and after membership, the concrete support of Turkey, Italy, and the United States continued.

During the Cold War period in 1990, the balance was on the security side and the military expenditures of the country were 5.9% of GDP. After democracy, the balance changed and the percentage decreased dramatically to 1.2% in 2000 (www.tradingeconomics.com/ Retrieved on 29 October 2015). Security expenditures continued to decrease for the sake of welfare. The defense budget increased to 1.6% in 2010 then decreased to 1.51% in 2011, 1.49% in 2012 and 1.36% in 2013 (www.providingforpeacekeeping.org/, Retrieved on 29 October 2015). After the 2013 election, the Socialist Party gained the power in parliament. The new government did not support the military and it was difficult to convince the ruling politicians about the threat. In other words, during the years 2014-2015, the main problem was defining the threat. For politicians, the absence of a threat and efforts to increase welfare resulted in dramatic cuts in security expenditures. In the 1920s, the discussion about the *need for the military* now inverted to discussions about the *need for a navy and air force*. Albania currently has 8,500 active defence personnel, including civilians, from which only 2,500 are combat ready, while the other two-thirds are executive and support staff (www.providingforpeacekeeping.org/, Retrieved on 29 October 2015). The defense budget for 2014 was 1.0% of GDP (www.sipri.org/, Retrieved on 30 October 2015), while it was 0.83% in 2015 (www.mod.gov.al/, Retrieved on 29 October 2015). This was obviously low compared to the NATO 2% level; the country received some criticism from NATO sources (Fig.1).

In 2015, Albania's Defense Spending Budget was 110,000,000 US Dollars, ranking 113th (www.globalfirepower.com/, Retrived on 12 September 2015). Additionally, according to the Global Fire Power (GFP) list, which uses over 50 factors to determine each nation's Power Index ("Pwrlndx") score, Albania is 100th, having a Pwrlndx of 2.5324 points (www.globalfirepower. com/, Retrieved on 12 September 2015).

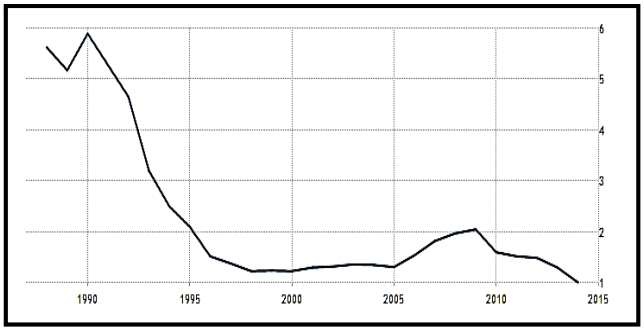

Fig.1. Albania's Defense & Arms Trade (World Bank Indicators, www.tradingeconomics.com / albania / military-expenditure-percent-of-gdp-wb-data.html, Retrieved on 29 October 2015)

Despite these results and after all developments, the Albanian army is in much better shape today than a decade ago. Morale is higher and the army has a clear sense of purpose and mission. The force is smaller, leaner, better fed, and better trained (Danopoulos & Skandalis, 2011). Lastly, there are two facts that must be mentioned. First, after the 2013 election, the new government focused on the police and spent a reasonable amount for the re-structuring of the police force. Expenditures for that re-structure are not included above because of a lack of sufficient input. Secondly, the amount of donations from allied countries is not included. For example, donations from Turkey alone in 2013-2014 reached 6 million US Dollars in the wake of continuing assistance starting in 1992.

4. Conclusion

Security expenditures are an important variable of economic indicators. Surely they are affected by political tendencies and the general circumstances of the world. In sum, security expenditures steadily increased after World War II and reached the highest level in 1987. After 1987, they began to decrease. In 1989, after the end of Cold War, expenditures decreased dramatically, even if they slowed in the middle of the 1990s, as the decreasing trend continued. As a result of the decreasing threat assessment, escalation in economic competition and the will to decrease the budget deficit, security expenditures decreased, as well. The United States decreased its military budget and personnel by 35% (Conetta, 2002). Even to meet the current basic needs and infrastructure maintenance expenses of the army has caused a great deal of resource use (Conetta, 2002). In 1999, expenses increased again and accelerated after 2002. According

to SIPRI estimations, the annual increasing rate of defense expenditures between 2002 and 2004 was 6% in real amounts (Başar & Künü, 2012). The reason for this increase was the United States' Afghanistan and Iraq operations (Taner, 2006). Currently, most of the money used for security is from developed countries. These 32 countries comprise of 16% of the world population but they cover 79% of defense expenditures. The poorest 58 countries cover only 4% of all defense expenditures, while they have 41% of the world population. It is clear there is a positive correlation between developed countries and defence expenditures (Sköns, 2005).

Albania's security-welfare balance history consists of practices in opposite sides. That means there is no balance between security and welfare expenditures. The balance was strongly affected by political discussions and perceptions. Again, it is obvious that generally there was not a rational balance in security-welfare expenditures in the Albanian case.

As shown in Figure 2, the strategy and its component "strategic management" is directly related to objectives and instruments. In our case, security and welfare both are objectives, while GDP and military/police are instruments. Using money and military/police to gain welfare and security is strategic management. In the Albanian case, the lack of balance between the two expenditures shows a lack of strategic management. In order to make a reasonable balance, as an instrument of strategic management, SWOT analyses can be the starting point, which is a duty of APL.

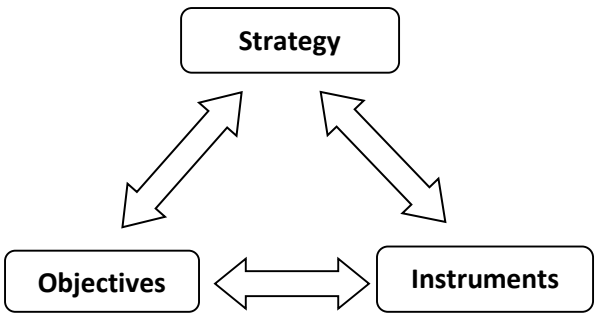

Fig. 2. Strategy Management Circle (Eren, 2006)

This paper discussed the relations and balance between defence expenditures and welfare in the chosen Albanian case. Albanian defense expenditures during the Cold War period are not clear enough because documents belonging to that period are not accessible or the subject is not focused sufficiently by academicians. A lack of official information from Enver Hoxha's time is a limitation of this research. On the other hand, since there is insufficient research focusing on the Albanian defence-security balance from a strategic management perspective, this paper makes a significant contribution to literature.

Lastly, studies using the Cold War period's original data can add an important contribution to literature.

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