Journal of Military & Information Science

JMISCI

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- ➢ Military or Non-military System Simulation
- ➢ Total Quality Management
- ➢ Forecasting, Military Forcasting Applications
- ➢ Multiobjective Decision Making

ABSTRACTING-INDEXING-LISTING

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Editorial

A Short Statistical Analysis of JMISCI Readers Based on Google Analytics Data

Kerim Goztepe

Dear Readers,

Happy New Year and welcome to 2016! It has been a privilege to serve you as the Editor-in-Chief for Journal of Military and Information Science (JMISCI) for three years. Serving as the Editor-in-Chief is not only an honor but also a responsibility to keep JMISCI up-to-date with the latest changes in the field of military and information science. It is my great pleasure to report that JMISCI has continued to do well in 2015.

We are about to start a new year, besides we celebrate the 10th issue of JMISCI. It is my privilige to inform you that Some widely used academic indexes as Directory of Open Access Journals (2015), Arastirmax (2015) and Scientific Indexing Services (2015) have started to index our journal. Besides, we have submitted to engineering index (EI-Compendex) and Proquest databases for indexing. JMISCI supported two international conference in 2015; ICMSS (International Conference on Military and Security Studies) and ICOVACS (International Conference on Value Chain Sustainability conference).

As JMISCI official supporting journal of ICOVACS 2015, , a special issue is included in this print. ICOVACS took place at Marmara University, Goztepe Campus, in March, 2015. This year's conference theme was "Performance Measurement in Operations Management", that discuss and examine the performance measurement in order to develop sustainable value chains.

Statistical Analysis of JMISCI Readers

Scientific journals offer wide and recent collection of current research in the related field of interest. It is known that a journal's content can impact the development of new technology, educating or daily life. They usually have peer review systems ensuring that articles have to provide some essentials for acceptance. At this point readers of a journal is crucial and provide valuable data for an evaluation. From this fact, I desired to survey a short study about JMISCI readers.

I applied two main data obtained from Google analytics (Google, 2015) for a short statistical study. These are sessions and page views of JMISCI. Data of 48 weeks are included.

Table 1. Data overview for 48 weeks (Based Google analytics, 2015)

Sessions (weekly)				Page views (weekly)			
23	89	269	67	24	377	658	129
20	128	317	93	20	736	667	351
15	316	301	50	34	760	339	187
83	234	287	75	473	208	386	347
145	120	142	127	611	477	426	484
118	274	142	103	365	372	141	293
108	224	235	241	527	298	239	774
367	252	58	282	1279	841	344	594
237	447	82	153	1049	700	267	331
192	448	76	137	593	412	194	601
94	249	68	86	647	437	257	314
119	110	79	132	361	596	244	256
Note: Data given in circle effects normality test. See Fig.1							

Descriptive statistics about "sessions" and "page views" data is calculated in Minitab (2014) and is given below(Table.2). We can conclude that readers open 167 session and visit 438 page in a week approximately.

Table 2. Descriptive statistics

Variable	N	Mean	SEMean	StDev	Minimum	Maximum
Sessions	48	167.0	15.5	107.7	15.0	448.0
Pageviews	48	437.9	36.9	255.6	20.0	1279.0

Another valuable issue about data statistics is to encounter probability of data (Montgomery et al, 2009; Spanos, 1999). Researchers use probability plots in order to determine whether a particular distribution fits given data or to compare different sample distributions. I applied Minitab "probability plot" to estimate the cumulative distribution function (cdf) and associated confidence intervals. Although the plotted points does not follow a straight line in some points exactly, we can conclude that data is normally distributed as seen in Fig.1. The reason is data of week 1-3 and week 9-10. Data is not similar in that week's (too smaller or too bigger) in comparison to others.
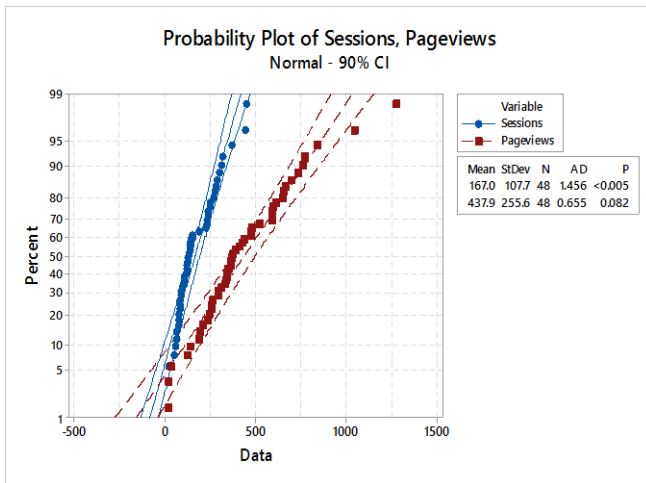
Fig.1. Probability plot of JMISCI data for (based on 48 weeks).

Time Series Analysis for JMISCI Readers Data

I guess, our readers interested in statistics are familiar with the topic of time series. Shortly, "a time series is a sequence of data points, typically measured at uniform time intervals"(Brockwell, 2013). Many researchers use time series in different fields ranging from sociology to engineering, and several methods

of analyzing time series appear as an important part of Statistics (Jacobs and Carmichael, 2002; Owen, 2001). I applied time series analysis in order to extract meaningful characteristics of the data and forecast future JMISCI readers behavior. Basic time series plot of sessions and page view according to week 1 to week 48 is given Fig. 2.
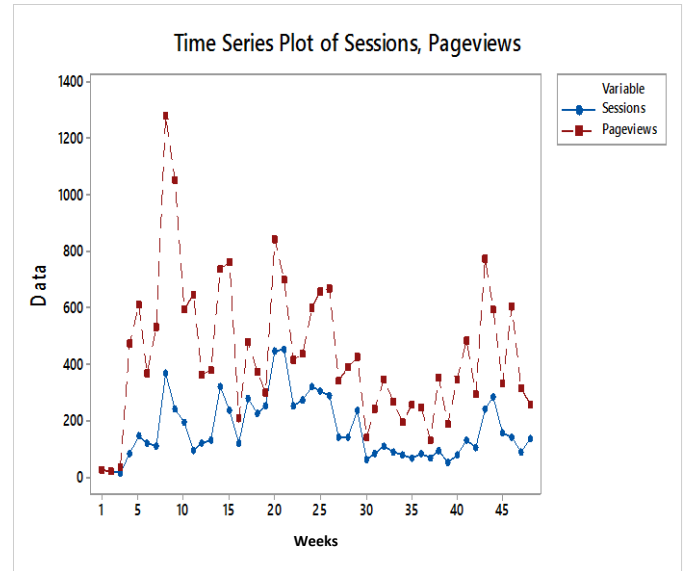
Fig.2. Time series for sessions and page views.

Readers opened 1279 and 1049 session in weeks 9 and 10. This data is strange in comparison to other weeks. I think the reason could be ICMSS participants and members.

Another issue is forecasting the readers trend. Basic question is "how many readers may open session and display JMISCI pages in future? In a one week or one month? I used "Winter' Method" provided by Minitab to find an answer for next 12 weeks. Green points describe the time series plot with 95% prediction interval bands (Fig.2 and Fig.3) . In this process, I assume that the time series is represented by the model;

$$y_t = (b_1 + b_2 t)S_t + e_t$$

Where; b_1 is the base signal, b_2 is a linear trend component, S_t is a multiplicative seasonal factor, e_t is the random error component (Kalekar, 2004). When we define length of the season as L periods, the length of the season will be

$$\sum_{1<t<L} S_t = L$$
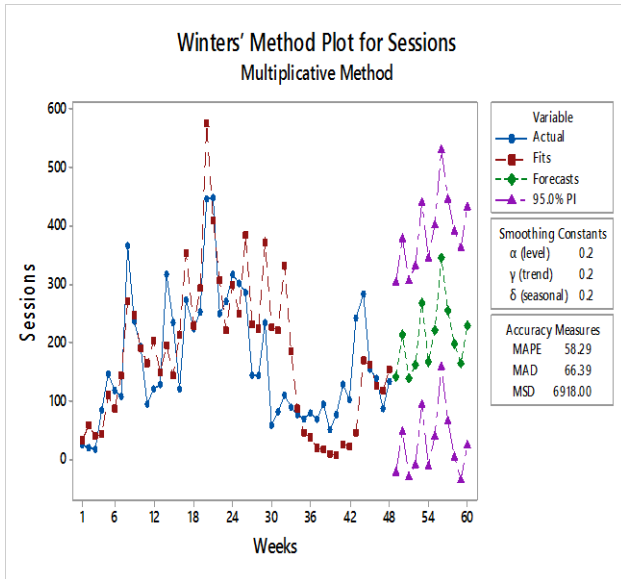
Fig3. Forecasting graphic for sessions.
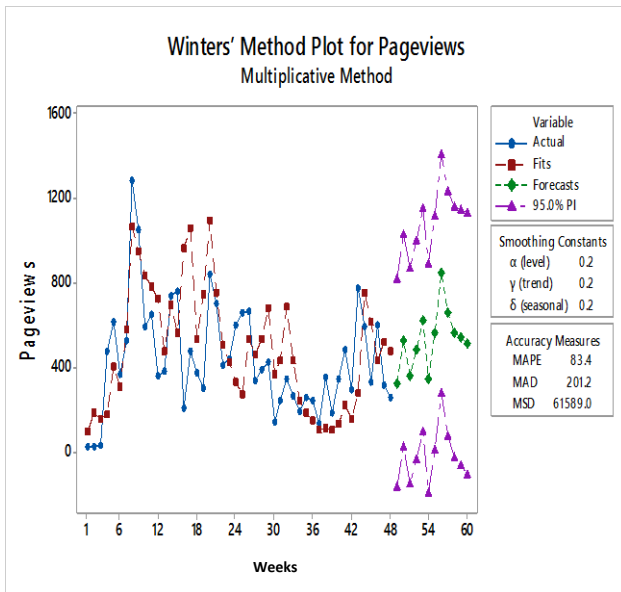
Fig3. Forecasting graphic for page views.

I want to make a short explanation about Winters' Method at this point. It polishes given data by Holt-Winters exponential smoothing and provides short to medium-range forecasting (Gelper and Croux, 2010). Researchers may apply this procedure when both trend and seasonality are present. The method computes dynamic estimates from point of view level, trend, and seasonal (Table 3). Minitab results

provide three measures in order to determine the accuracy of the fitted values: MAPE, MAD, and MSD.

Table 3. Winters' Method forecasting results for Pageviews

Data	Pageviews		
Length	48		
Smoothing Constants			
α (level)	0.2		
γ (trend)	0.2		
δ (seasonal)	0.2		
Accuracy Measures			
MAPE	83.4		
MAD	201.2		
MSD	61589.0		
Forecasts			
Period	Forecast	Lower	Upper
49	324.930	-168.055	817.92
50	527.629	26.920	1028.34
51	357.843	-151.478	867.16
52	480.295	-38.481	999.07
53	622.107	93.076	1151.14
54	346.523	-193.515	886.56
55	561.464	9.710	1113.22
56	844.561	280.427	1408.69
57	655.014	77.879	1232.15
58	565.338	-25.379	1156.06
59	538.615	-66.224	1143.46
60	513.263	-106.204	1132.73

I tried to explain definitions of MAPE, MAD and MSD which appears in Table 2 below. Mean Absolute Percentage Error (MAPE), measures the accuracy of fitted time series values. Because this number is a percentage, it can be easier to understand than the other statistics. Mean Absolute Deviation (MAD), expresses accuracy in the same units as the data, which helps conceptualize the amount of error. Mean Squared Deviation (MSD) is always computed using the same denominator, n, regardless of the model (Minitab, 2014). We can forecast that readers may open 325 pages in week 49 and 844 pages in week 56 according to Table 2.

2015 is a successful year for JMISCI when we examine Google reports (See Appendix) and feedbacks from authors/readers. I would like to thank Col. Kadir Canpolat (Army War College), Prof.Dr.Cengiz Kahraman (ITU), Prof.Dr. Şeref Sağıroğlu (Gazi University), Prof.Dr. Orhan Torkul (Sakarya University), Assoc Prof.Dr. Hakan Tozan (Navy Academy), Assoc.Prof. Dr. Özkan Bali (Military

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Academy), Dr. Şahin Çetin (Army War College), Dr. Alper Kayaalp (Army War College), Dr. Zafer Özleblebici (Army War College) and all lecturers who have supported us during 2015.

International Conference on Military and Security Studies, ICMSS 2016

Turkish Army War College (TAWC) is pleased to invite colleagues from other war colleges as well as researchers in military, security, information and international affairs to the annual "International Conference on Military and Security Studies". The conference will take place March 14-16, 2016 in Istanbul, Turkey.

We wish you a happy and successful year. We look forward to having you with us in 2016.

Sincerely,

Kerim Goztepe, IE, Ph.D
Editor-in-Chief
Journal of Military and Information Science

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APPENDIX

Worldwide access to JMISCI. Graphics given below, provides descriptive information about sessions, users, pageviews of JMISCI for 48 weeks.

Goztepe,K. (2016). *A Short Statistical Analysis of JMISCI Readers Based on Google Analytics Data, Journal of Military and Information Science, Vol.4(1),1-5.*
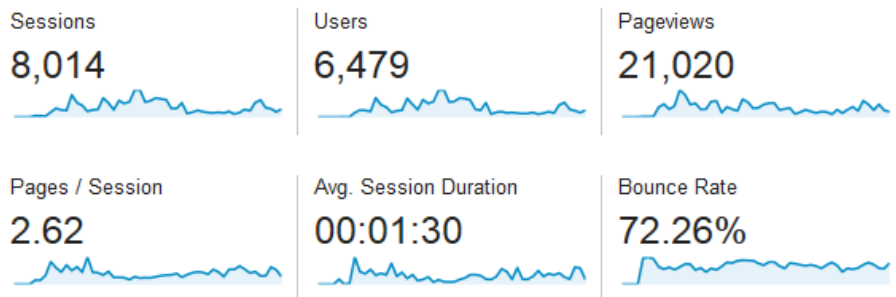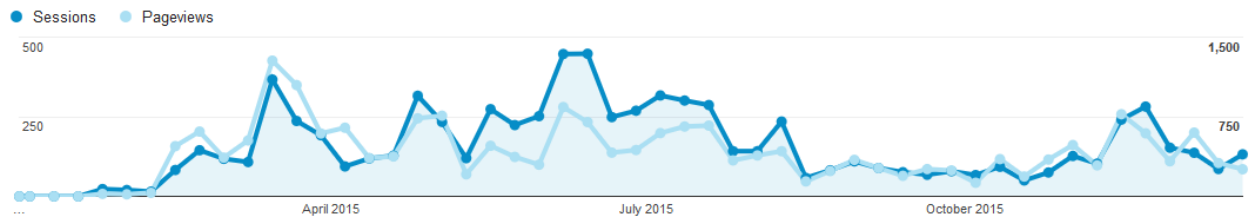
Research Article

Stress and Absenteeism in Civilian Employees Supervised by Army Sergeants: Empirical Evidence from Fort Belvoir, Virginia

Carey Williams, DM*, Ravi Chinta, Ph.D.**‡

* Fredericksburg, Virginia, e-mail: careyjns1@aol.com tel. (703) 879-5800
**Business Administration Department, College of Business, Auburn University at Montgomery

‡ Corresponding Author Address: Business Administration Department, College of Business, Auburn University at Montgomery, Montgomery, AL 36117   Tel: +01 513 262 5512, Fax: +01 334 244 3792, e-mail: ravichinta@hotmail.com

Abstract: Past literature suggests that leadership style impacts employee attitudes and job performance in organizations. Given the broad scope of military operations, there are many situations in military where military managers supervise civilian employees. Our empirical study explores the effects of Army sergeant supervision of civilian employees at Fort Belvoir, Virginia. Several themes in Army sergeants' perceptions as supervisor of federal civilian employees were studied in-depth: (a) task, (b) education training, (c) family, (d) rules & regulations, (e) open communications, (f) last minute task, (g) direct leadership, and (h) experience. Our findings show that a mismatch between leader perceptions and employee expectations leads to stress and absenteeism. Implications for future research and suggestions to reduce stress and absenteeism are discussed.

Keywords: Military Managers, Civilian employees in military, Stress, Absenteeism, Supervision.

1. Introduction

The United States Army staffs more than one million military and civilian men and women, many who are extremely young and inexperienced; they then find themselves thrust into positions of high responsibility (Hargrove & Sitkin, 2011). The Army conducts many lessons for its military leaders in organization for problems it faces (Hargrove & Sitkin, 2011). Military leaders are trained to follow rules, military laws, and regulations under a rank structural base process.

In the face of adversity, leaders must know each member of the organization in an effort to be effective and avoid derailment (Yukl, 1990). Military leaders' influence over civilian personnel has been studied since the 1960s, examining the effects military leaders have on civilian employees and their work relationships (Kelier, 1965). Dvir, Eden, Avolio, and Shamir (2002) examined the impact of military leaders in charge of federal employees, on self-development, and direct performance.

Thousands of civilian employees work for military organizations (Powers, 1999). The general problem is civilian personnel working under the supervision of military leaders are often treated as soldiers by military leaders and this may cause stress and conflict in the workplace (Cazzaniga, 2009). There is a specific problem of stress and absenteeism of civilian employees working for United States Army sergeants at Fort Belvoir, Virginia. This empirical study aims to investigate this phenomenon to propose mitigation strategies.

2. Literature Review

Military organizations are increasingly integrated with the civilian workforce since the 1960s (Kelier, 1965). The relationship between civilian and military

leaders has been at the forefront of society in the political and historical realm, realigned with peacetime and wartime threats (Langston, 2008). Military organizations have three components (superiors, supervisors, and subordinates) that is found in both military and civilian environment, which involves various psychological and social dimensions to organizational leaders' relationship uncommon in nonmilitary organizations (Holloman, 1967). A large percentage of federal employees have military experiences or are retired from the military. Many of them served in positions that were abolished by the new military structure at the start of the Gulf Wars in 2003 (Copeland, 2008).

Their experiences support the military war fighting efforts as civilian employees (Copeland, 2008). A large portion of federal employees are military spouses, some are stationed abroad and had to place their careers or jobs in the United States on hold. Frequent deployments of service members and federal employees resulted in high demands of military families. High levels of stress became a common trend among military families, soldiers, and federal employees (Allen et al., 2010; Karney & Crown, 2007; Rosen & Durand, 2000).

Fort Belvoir, Virginia, which has a multicultural and diverse population, consists of more civilians than military members. The base primary role is to support war-fighting organizations prepare for future deployments. There are more senior civilians than senior military leaders working on the installation. The Fort Belvoir, Virginia military base expanded its civilian population because of the war on terrorism and base realignment that began in 2011. Several hundred diverse federal employees workforce from Department of Defense organizations, and Department of the Army agencies relocated to Fort Belvoir, Virginia military installation for national security purposes. The installation expanded its infrastructure to accommodate military and federal agencies within the Washington, DC capital region.

Marina and Ellert (2009) States that Army personnel, he or she is either civilian or military has a military hierarchy. According to Marina and Ellert (2009), the Army (2006b, 33), influenced beyond the chain of command, has four competencies: "(a) understanding the sphere of influence and limits of influence, (b) building trust, (c) negotiating to build consensus and resolve conflict, and (d) building and maintaining alliances". Hickman (2010) argued that an organization faces many challenges with responding to diverse environments. The acceptance of a colorblind

or multicultural diversity workforce faces scrutiny from within (Hickman, 2010). Primarily, non-minority individuals have a much harder time working in an environment in which attention is given to certain groups of people (Hickman, 2010). A minority who experiences exclusionary behavior feels isolated and devalued as a member of the team, and member alienation ensues (Hickman, 2010).

2.1 Leadership Styles

Yukl (1989) argued that for leadership effectiveness in an organization, there must be an environment that is considerate, supportive, and caring for subordinates in the organization. Displaying a high level of trust, confidence, friendliness, consideration, and open-mindedness to understand individual problems, including careers, and rewarding good performances are signs of an effective leadership style (Yukl, 1989). Leaders who used a general style of supervision versus a close supervision tend to have a more effective organization (Yukl, 1989).

Senge (1990) highlighted two vision attributes: positive and negative. Positive vision emphasizes change and aspirations for development, and negative vision continues the status quo under the complex challenges of environments (Hickman, 2010; Senge, 1990). "Although vision is emphasized as a core issue in the prevailing vision-based leadership theories (Bass, 1990; Conger & Kanungo, 1987; Tichy & Divanna, 1986; Westley & Mintzberg, 1989) several characteristics of effective vision are shown, but no prevailing theories has exhaustively explained how each characteristic might create change in the organizations performance" (Hickman, 2010, p. 263).

These role senders exert pressure on the manager to conform to their beliefs about the correct way to act (Yukl, 1989). Role expectations for leaders are influenced by cultural norms and values (Yukl, 1989). He argued that the role expectations from subordinates and peers communicate orally, while the role expectations from supervisors and managers are often in writing and orally (Yukl, 1989). Leaders in organizations are given written job descriptions and guidance enumerating their duties, roles, responsibilities, authority, organization policies, and regulations pertaining to their administrative position (Yukl, 1989). The perception of the leader's role requirements is shaped around these prescriptions and prohibitions, as well as the day-to-day functional role as the leader (Yukl, 1989).

According to Kean and Haycock (2011) "…understanding the relationship of followers and

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leaders" suggested mainstream leadership development frameworks appear fixated on the idea leaders are always in control and leading. Kean and Haycock (2011) stated, "At the same time, leadership development frameworks, and many contemporary leadership approaches, make the assumption that followers make up a homogeneous group that unquestioningly follows a leader" (p. 32). Military leaders are motivated to accomplish his or her mission; however, last minute tasks shifts leadership styles from participatory to a direct approach with military and federal civilian employees. Direct leadership styles could bring about more stress to the work environment. A survey of 210 personnel at the Inspectors General Auditor Training Institute (IGATI) indicates that 39% of subordinates reject leaders' direct style of leading (Campbell, 1993).

The study underscores the importance of leaders who fail to recognize the needs of followers in the organization. Kean and Haycock (2011) described the perception of managers and leaders who feel that if subordinates stand by for instructions they are a good follower. Many leaders who allow followers to standby on the sideline and wait for someone to offer instructions can become problematic in the organization (Kean & Haycock, 2011).

Salimi, Karminia, and Esmaeili (2011) discussed various management styles and conflict management within a military environment relating to styles of leadership of military organizations. A variety of different instruments were used to assess the style of conflict methodology adopted by management for problem-solving (Salimi, Karminia & Esmaeili, 2011). The majority of respondents preferred to use a participatory type of leadership style to communicate with members of the organization. Based on the study, compatible personality traits are the most frequently used by senior level management (Salimi et al., 2011).

Compared to findings conducted in the United States, Turkey, and Jordan, a degree of consistency with trust, cooperation, and good deeds was discovered with each person from the study to have the same compatibility (Salimi et al., 2011). The study found that eight of the individuals who were compatible were together for more than eight years and deployed with the same organization for war, and to date, personality traits were consistently kept the same (Salimi et al., 2011).

Changes in leadership style can place a great deal of pressure on personnel in the organization (Bons, Bass & Komorita, 1970). When new leadership takes over, such as change of commanders in the military

chain of command, everyone in the organization is affected (Bons et al., 1970). Bons et al. (1970) investigated organizational leadership dynamics and the impact they have on members of the organization. Bons et al. (1970) argued that a great amount of research involving leadership styles and organizational effectiveness with teams however, very little change was found with individual scores as relate to task based on peer pressures.

According to Covey (1991), there is great diversity and mobility in organizations today, and leaders are challenged in congruent leadership styles. Leaders' styles can be situational; however, before one can make a difference in organizations, new mentors and models must be in place (Yukl, 2010). Bons et al. (1970) used a combination of instruments to assess the predictors of effectiveness of leadership. Two frequent used approaches was adopted from Fiedler's (1964) study between opposites; (1) rating of the person *most preferred*, and (2) *least preferred* (Fiedler, 1964) and the Ohio State leadership study on consideration and initiating structure, Likert, attitude scale (Bons et al., 1970; Stogdill & Coon, 1957). The two leadership styles (ASO-LPC and Consideration Initiating Structure) were used at the beginning of the assessment to assess personality characteristics between leaders (Bons et al., 1970; Fiedler, 1964).

The purpose of the Bons et al. (1970) study was to measure the effectiveness of leaders who are similarly situated in organizations using Fiedler's (1958) ASO-LPC and Consideration Initiating Structure. The Contingency Model of Fiedler (1964) suggested that both concepts can be equally represented when placed in certain situation or groups. Additional research was recommended to determine if the leadership styles are related to changes in the effectiveness of the leader (Fiedler, 1964).

De Vries, Bakker-Pieper, and Oostenveld (2010) investigated the relationship between leaders' communication style, knowledge sharing, and the outcome in organizations (Devries, Bakker-Pieper, & Oostenveld, 2010). The authors compared non-interpersonal relationships of leadership styles and the challenges on individuals interpersonal aspects of leadership surrounded planning, organizing, and decision-making and/or problem solving (De Vries et al., 2010). The purpose of the previous study was to understand the commonality of leadership styles as it relates to leader communication measured by the authors. There is a growing interest in the predictors of knowledge sharing (De Vries et al., 2010). Leadership has a central responsibility to inspire and support

knowledge sharing and behavior (De Vries et al., 2010).

2.2 Job Satisfaction of Employees

Leaders of the 21st century should know that once leadership roles have been distributed to members in the organization, the next goal is to ensure the employees in the company are satisfied with his or her jobs (Wren, 1995). In previous years, leaders received solid results from employees for short term, using non-empowering methods, including intimidation tactics, force, and care taking (Wren, 1995). Concerned with preparing people for jobs with higher responsibility, some agencies ignore research literature stating the difficulty in managing and leading (Kotter, 1990/2008). Taking care of members in the organization is a leader's responsibility (Yukl, 2010). An unhappy employee tends to look for a new job when they are not satisfied with the one they currently hold (Yukl, 2010).

Job satisfaction is defined as "...the individuals' attitudes toward the various aspects of their job, as well as towards the job in general" (Gill, Sharma, Mathur, & Bhutani, 2012, p. 191). Locke (1969) defined job satisfaction as the pleasurable emotional state that results from the appraisal of one's job as achieving or facilitating the achievement of one's job values (as cited in Gill et al., 2012). Perceived job satisfaction creates positive feelings among employees, which in turn, represents positive emotional reactions towards desire for empowerment (as mentioned in Gill et al., 2012).

Satisfied employees desire an environment created for the team and one that pays a salary that is suitable (Bennis & Mische, 1995). An environment with dedicated working space must present free and have an open exchange of ideas and information (Bennis & Mische, 1995). According to Gill et al. (2012), the perception in which job satisfaction leads to job involvement that workers begin to involve in their roles as employees (Gill et al., 2012). As stated in Taylor and Vest (1992), "Public sector managers found that those public sector employees who compared their salaries with private sector employees, had lower levels of job satisfaction, thus concluding that pay levels affect job satisfaction" (p. 120).

2.3 Stress in the Working Environment

Leadership and management styles have a direct connection to employers and employee stress, which has positive and integrative styles related to transformational leadership that engender participants at every level of leadership (Sisley, Henning, Hawken, & Moir, 2010). Workplace stress exists when undue pressure is applied as a consequence of tasks or conditions that occur in the work environment during the course of an employee's assignment to the organization (Sisley et al., 2010). Factors contributing to stress are related to demographic factors, job-demand characteristics, leadership and management, working in interdisciplinary teams, and the advent of conflict scenarios' (Sisley et al., 2010, p. 4).

Army sergeants in charge of federal civilian employees grew as a result of the Gulf Wars in 2003, after several hundred military members were deployed to Iraq and Afghanistan (Copeland, 2008). Military leaders experienced stress related disorders during and after returning from deployments (Smith-Forbes, Najera, & Hawkins, 2014). Smith-Forbes et al. (2014) underscored the importance of the military working environment and the interaction of stress rather adaptive or maladaptive for survival for mission accomplishment, which could lead to misconduct and disciplinary action, ranging from discharge to imprisonment.

Combat Occupational Stress Reactions (COSR) are a combination of expected, predictable, intellectual, physical, emotional, or behavioral reactions of military members who have been exposed to combat stress or training operations simulation of wars (Smith-Forbes et al., 2014). Studies of troops returning from deployments to Iraq and Afghanistan agreed that there is an increase prevalence of behavioral health issues found among service members who returning from combat (Mattila, Crandall, & Goldman, 2011). Recent literature reported approximately 20% to 40% of over 2 million service members who have deployed in support of Iraq or Afghanistan between 2003-2010, did so with some type of behavioral health issue such as depression, anxiety, posttraumatic stress disorder (PTSD), or substance abuse (Mattila et al., 2011).

2.4 Gaps in the Literature

The review of the literature demonstrated a need for more empirical studies focused on military supervisors. Previous literature failed to yield enough peer-reviewed research journals on the lived experience of Army sergeants in charge of federal civilian employees who may suffer from stress or absenteeism. The existing literature does not include studies about the central phenomenon of Army sergeants' experiences of supervising federal civilian employees. A gap remains in the literature regarding Army sergeants who may suffer from stress or absenteeism in leading federal civilian employees in the 21st century. The current study aims to fill this gap in extant literature.

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3. Methodology

The purpose of the current study was to explore and understand in more depth the phenomena of lived experiences of Army sergeants who supervise federal civilian employees working under the leadership of military leaders. The data includes interviews from 15 Army sergeants' feelings, beliefs, perceptions, attitudes, and their personal insights with federal employees on the job at the United States Army Fort Belvoir, Virginia military base. The research strategy focused on the use of open-ended questions with purposeful sampling strategies. Moustakas (1994) argued that phenomenological reduction is not just a way of viewing, but listening attentively with awareness and deliberate intention of opening to phenomena as phenomena in one's own perspective, texture, and meanings. The phenomenological design may provide answers for the study by helping to understand the lived experiences of Army sergeants who supervise federal civilian employees at Fort Belvoir, Virginia.

3.1 Research Questions

Phenomenological study aims to identify the relationship of federal employees working under the leadership of military supervisors on a joint military environment. According to Neuman (2007), research questions drive the need for the study and are the central focus for researchers (Neuman, 2007). Qualitative research questions must be presented in a general, broad type form so that research participants can share their lived perspectives/experiences (Creswell, 2005).

RQ 1: What are the lived experiences of Army sergeants who supervise federal civilian employees working under military leaders who may suffer from stress related disorders?

The purpose of research Question 1 was to evaluate the participants' perceptions about past experiences and their beliefs of the working relationship between their federal civilian employees at Fort Belvoir, Virginia.

RQ 2: What communication styles promotes a positive work environment of military leaders who supervise federal civilians and why?

The purpose of research Question 2 was to understand the lived experiences of participants, and personality, emotions, and perceptions of a military supervisor leadership style in a diverse working environment.

RQ 3: What are the Army sergeants' perceptions of leading federal civilian employees in the 21st century?

The purpose of research Question 3 was to understand through the lens of participants' lived experiences the day to day working condition and environment of how military leaders impact federal employees with stress and absenteeism in the 21st century.

RQ 4: What leadership behavior if any, influence absenteeism?

The purpose of research Question 4 was to understand the Army sergeants' attitudes, feelings, patterns of leadership behavior that influence federal civilian employees behavior while living and working in a military environment.

3.2 Sample

The Fort Belvoir, Virginia is managed by military leaders under careful directions of a deputy civilian leader. A deputy civilian leader is equivalent to a chief executive officer (CEO) of a company. The deputy is next in charge of the organization under military general officer or a colonel (O-6) in the military. The majority of the workforce is federal civilian employees whose salaries range from $15,000 to $150,000 annually (Labor Statistics, February 2012).

The research sample included 15 Army sergeants who supervise federal civilian employees' lived experiences while working at Fort Belvoir, Virginia. Leedy and Ormrod (2007) recommended a sampling size of 5-25 participants for qualitative research for qualitative research study (Creswell, 2007; Leedy & Ormrod, 2007). These 15 Army sergeants have been in the Army for more than five years, and currently have more than one year of supervisory experience of federal civilian employees at Fort Belvoir, Virginia. The five step process identified by Groenewald (2004) served as a guide for the data collection: (a) bracketing and phenomenological reduction- closely listening the recording of the data; (b) delineating units of meaning- units, issues of relevance, frequency of occurrence, and manner of statement as each played a pivotal role to eliminate redundancies; (c) clustering of meaning units to form themes-this process opened opportunity for areas of significance to serve as bases for emerging themes; and (d) summarizing each interview-revisit the data after theme has been finalized (Groenewald, 2004; Moustakas, 1994).

The selected participants for this study represented diversity of military leaders serving in leadership roles as Army sergeants in charge of federal civilian

employees with profound experiences. There were 15 total participants in this study. The sample consisted of 53% females and 47% males. The ethnicity of each participants included 13% Hispanic, 20% Caucasian, and 67% Black. The age of the participants ranged between 26-65 years old; 40% were between the ages 26-40 and 60% were between 41-65 years old.

More than 87% of the participants had at least 15 years of active military service in the United States Army. There were more than 93% of participants with 10 or more years as a leader. Deployment was not a requirement to participate in this study; however, the study showed 67% of the participants deployed to combat zone at least twice in his or her career, 27% had deployed to combat at least three times. Only one (6%) of participants never experienced deployment to a combat zone. At least 60% of the participants spent 12 months deployed in a combat zone; and 13% served more than 18 months in a combat zone.

At least 53.3% of the participants had more than five years of supervision experience of federal civilian employees. Participants must have served at least one year as a supervisor of federal civilian employees. The sampling and interviewing process moved along in a purposive fashion, keying in on the individuals who had important information pertaining to the study. In-depth unstructured interviews began with all participants using bracketing techniques moving from specific to personal details and more global and abstract process of the participants lived experiences (Shank, 2007). Interviewees were contacted through personal communications by the investigator at Fort Belvoir, Virginia and by e-mail.

3.3 Geographic Location

The geographic location of the United States Army sergeants is at Fort Belvoir, Virginia, in the Eastern part of the United States. There are 6,732 federal employees employed at Fort Belvoir, Virginia and 5,093 military personnel. The military base is located outside the city limits of Alexandria, Virginia, and approximately 10 miles from Washington, District of Columbia. The Fort Belvoir military base is two miles from the home of the first President of the United States, George Washington, (City of Mount Vernon, Virginia) attracting thousands of tourists year round.

3.4 Interview questions used for this study:

➢ Please describe your perception and experience of stress in the workplace.

➢ How does your level of experience as a sergeant in the Army relate to supervising military members and is there a difference?

➢ How does your level of experience as a sergeant in the Army relate to supervising federal civilian employees?

➢ Based on your position as a sergeant in the Army in charge of civilian employees, please describe how it affects your ability as a leader.

➢ What kind of experiences has caused stress to you that has affected your team or employees work habits?

➢ Please describe how you deal with employees who take frequent sick leave.

➢ How do you assist employees in dealing with uncertainties and challenges facing the Army during time of war?

➢ Please describe your style of leadership and a time when it worked best for you.

➢ Please describe your perception of how your behavior or attitude shifts when faced with stressful situations.

➢ What impact might stress or absenteeism have on the Army and your personal life?

➢ As a participant in this interview and your discussion on stress and absenteeism, what perceptions do you now hold about stress or absenteeism?

➢ Do you have any thoughts or concerns you would like to share about your perceptions and experiences as a sergeant in Army in charge of federal civilian employees not covered in this interview?

4. Results

Eight common themes emerged through the data analysis process: (a) treatment of people, (b) communication, (c) supervision of military v. civilian members, (d) rules and regulations, (e) style of the leader, (f) training, (g) hostile working environment, and (h) experience. Analysis of the data followed the application modified van Kaam method by Moustakas (1994). Qualitative analysis software NVivo 10® was used to systematically code, organize, and categorize the data in revealing similar patterns and themes. The research instrument template and interview scripts were developed before the start of the interview in an effort to manage and control the data. Participants' code, time

and date were recorded and placed in the audio recorder folder.

The computer software program NVivo 10®, was used to analyze the data for patterns, clustering, and themes. The program combined efficient management of non-numerical, unstructured data with powerful processes of indexing, searching, and theorizing (Creswell, 2008). Additionally, NVivo 10® software program helped to make sense of complex data; as it was an excellent tool for rapid coding, thorough exploration, and rigorous management and analysis of this study (Creswell, 2008). This concept is called horizontalization or listing of every relevant expression of the experience (Moustakas, 1994).

4.1 Findings

Question 5. Question 5 was, "What kind of experiences has caused stress to you that have affected your team or employees work habits? As shown in Table 1 below, four out of 15 (27%) participants believed that last minute tasks or short suspense causes stress and affected his or her team and employees work habits. Participant PS005 expressed,

"Some of the things that I have experienced could be, that we as sergeants in the United States Army have a task and purpose as compared to my civilian counter parts; they go day by day or as time progresses. They really don't have a 'things to do list' I write myself a things to do list; I write them down and prioritize. My counterparts or civilian leaders would say that they would get to that whenever they can if it is not a hot issue."

Table 1: *Response to Question 5 (N=15)*

Prevalent Themes	Frequency	%
Last minute tasks/short suspense	4	27
Disciplinary actions	3	20
Push Back	2	13
Sequestration	2	13

Participant PS012 stated,

"I sometimes tend to internalize it and carry it home, so that stress I bring back to the workplace, and of course my employees or team members are going to experience it. I do control anger pretty well, but it is probably like, "Hey look, I just need this now or I needed it yesterday and you still don't have it done," so my tone will change in terms of how I'm asking for something. That's not how it was yesterday. I think the

stress is because I will be internalizing a lot of the issues that are unresolved."

Participant PS009 described,

"The kind of experience I have that causes stress for me and affects my team and the work environment is last minute tasks that the employees know about beforehand; last minute tasks or missions that have to be accomplished."

Participant PS010 shared,

"Not meeting deadlines or mission due to one of my civilian employees dropping the ball, and not being able to discipline the civilian in the manner in which I would do for a military personnel."

As shown in Table 1 above, three out of 15 (20%) participants believed disciplinary actions caused stress and affected his or her team. Participant PS009 expressed, "I had a lot of stress would try to curb my authoritarian voice, wording, and behavior when speaking with civilian employees for disciplinary actions."

Participant PS013 explained,

"I have had a few experiences where it becomes stressful when it comes to disciplinary actions when a federal employee does not do his or her job or specific task or duty like they are supposed to. Not doing the things that they are assigned or does not show passion, and not doing what they know is the right way. Because of this we have learn how to deal with soldiers when they have issues rather than simple corrective training, Uniform Code of Military Justice [UCMJ], counseling."

Participant PS014 expressed,

"When you are working with civilians, the ripple effect is worst, for example, last year when the federal employees experienced sequestration and furloughs. That was probably the most stressful time for me on the team, I could see part of what civilians were going through, but I really didn't know because I am a soldier, and how it affected me and how it affected them was going to be totally different."

Question 6. Question 6 was, "Please describe how you deal with employees who take frequent sick leave." As shown in Table 2 below, seven out of 15 (47%) believed you should talk with the employee or soldier and see what services is needed.

Participant PS011 explained,

"As part of the program and services, we provide support to Army casualty assistance, funeral honors,

congressional, sexual assault response and prevention, evaluations, voter assistance, publications, DDR which is drug demand reduction program, and safety. All of these programs fall under well-being, so for us we have to be available to assist where we are needed in our respective programs. That is not always from 7:30-4pm Monday through Friday. Folks notice this, particularly when you conduct casualty training, and some casualty trainings are offered Monday-Friday and maybe one or two days a week throughout the month."

Table 2: *Response to Question 6 (N=15)*

Prevalent Themes	Frequency	%
Talk to the employee/soldier	7	47
Provide Counseling	3	20
Check for Medical Reason	5	33

Participant PS005 stated,

"I will talk with the individual first, but if it's a reoccurring thing and not really legit that I am aware about as the supervisor, I might question it and talk one on one to see what is going on with that person or family. If it affects the workload, then I seek out a plan of action to put in place."

Participant PS015 described,

"The way I deal with it, I try to have a talk with them to see if there is something going on that I can't see that they may need help or advice on as to why they are being absent more than normal. Best to get to know the person to see if there is any way I can assist in taking care of the situational problem that they may have."

Participant PS007 stated,

"They talk to our soldiers and help them improve on their physical training, weapons qualifications. I would send our civilians to talk with them as well, everything is confidential, and it is not like they would tell me what the member said. I think this is a good avenue to go."

Participant PS014 expressed,

"Depending on their demeanor or if it is something that they feel that we can talk about in their areas we will talk or we can talk in my office. I would not be in direct conversation telling them that they have been gone all this time, ok what's going on. It would be a more subtle approach, because if you come in too hard they will look at you as if you were crazy and shout

down on you. You have to ease into it, that's what I would do."

As shown in Table 2 above, three out of 15 (20%) participants deal with employees who take frequent leave of absent through counseling.

Participant PS012 stated,

"Due to the unions and regulations I am not a judge of whether it is a true sickness or not, it is just if they have the sick days to do it. It is an issue of pre-planning for me, and an issue of ensuring that I have other employees cross-trained; that way, during sickness or emergency or leave, we can still accomplish what we need done."

Participant PS006 described:

"If an employee takes frequent sick leave or leave of absence, first, I am going to make sure to get with the employee and let them know my concerns about the frequent leave of absence. We have regulations in place to address this problem."

Participant PS006 shared the following:

"By regulations civilians who are absent more than three days must produce a doctor's excuse. I stick with the regulations, policies, and procedures for employees who I feel are abusing it. I can follow the regulations that allow me to place them on leave restrictions. I would counsel the employee and let them know my concern and or place them on leave restrictions."

Participant PS010 expressed,

"If they have medical documentation and it is legit I have no problems with absenteeism. When it becomes excessive, then they would need to seek employment elsewhere."

As shown in Table 2 above, five out of 15 (33%) participants believed medical reasons could be the cause for employees taking frequent sick leave.

Participant PS010 explained,

"People become ill; however, when it becomes chronic behavior of calling out sick, and there is no documentation to support the illness, I take action to retrain or replace, or accommodate them, based on a disability. The employee may need to tele-work. At the end of the day we have to complete our mission."

Participant PS011 stated:

"I personally have employees who take frequent sick leave, and I have no problem with that, some people do and I'm not one of them. Some employees have medical situations that they don't discuss with you

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and I'm ok with that as long as I know you are performing whenever you are at work. It is not the absenteeism; it is whether or not you meet the requirements of your position, your duties and responsibilities."

Participant PS009 expressed, *"I must make sure that they have all their documentations in order."* Participant PS010 stated, *"If they have medical documentation and it is legit I have no problems with absenteeism."*

Participant PS008 shared,

"One the guidelines for civilians are s to provide medical notice after 2-3 days to support their time out of the office or took off. I think you have to take a moment and analyze what the time off sick leave is for, i.e., surgery, or after effects of having a surgery or things of that nature. Implement a policy and when there is a violation of that policy, you have to reprimand accordingly."

5. Discussion

The synopses of the responses encapsulated the essence of the voices of the participants pertaining to his or her lived experiences for this study. The voices and perspectives of participants integrate the firsthand knowledge of the Army sergeants who participated in the study and provided insights about supervising federal civilian employees who may suffer from stress and absenteeism. The research questions were intended to appropriately support the purpose of this investigation, and to gain knowledge and understanding from the experiential perceptions of Army sergeants in charge of federal civilian employee who may suffer from stress and absenteeism. The question design set the activity, mode and mood for open and honest sharing of Army sergeants lived experiences from his or her perspective (Leedy & Ormrod, 2010). The objective of the investigator is to present and interpret conclusions drawn from the literature review, the methodology, and the analysis of the data.

Values play important roles in determining how we function as individuals, family members, and members of work teams. Values drive behaviors. A value is "an enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence" (Rokeach, 1979). Our study reveals that Army Sergeants' values (e.g. focus on mission accomplishment) may not be fully shared by civilian employees and this mismatch may be causing some stress and absenteeism. Goal congruence between military managers and civilian employees can mitigate

this source of stress and absenteeism (Kouzes and Posner, 2012). We recommend regular workshops on mission and goals between the military managers and civilian employees as a way to coalesce the military and civilian mindsets at Fort Belvoir, Virginia.

5.1 Limitations and Implications

The findings for this study are not generalizable to the entire population of Fort Belvoir federal civilian workforce, who serve under the leadership of Army sergeants. Following the same aspects of this study, a quantitative or mixed approach to this research study may provide positive and or negative impacts to military leaders' style and influence in the federal workplace. Such replication studies with a larger number of respondents can lead to statistically significant relationships that would enhance the generalizability of these findings. Below are several suggestions for directions for future research.

Expanding the study to include Army Officers in charge of federal civilians working under the leadership of military leaders across the United States or Virginia might show stronger data relating to stress and absenteeism in the workplace. This information would provide the federal civilian and military communities with additional knowledge, awareness, and understanding for improvement, and to develop federal civilians' and soldiers' critical skills necessary for future challenges emerging in the 21st century.

Another possible area for future study is cultural diversity in the workplace, and how it relates to population of a different generational era (Fisher & Crabtree, 2009). Depending on the generation from which the leaders are from versus the federal employees' generational era, there could be an effect on the environment that he or she leads in the future. Based on organization shortages of critical skills in the commonplace today, domestic and global organizations must focus on workforce optimization for bottom-line results (Hickman, 2010; Moran, Harris and Moran, 2011).

Examining how military leaders design and manage working conditions in other services will provide the Army sergeants and military communities with recommended standardized operating procedures (SOP) for achieving organizational mission and goals. Research shows that stress is a multifaceted phenomenon. Stress is a complex entity, and what may be stressful to one person is not always the same for another (Gilchrist-Petty & Folk, 2014). Another possible area for future research study is job satisfaction. The data only provides information on

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small sample (15) Army sergeants' lived experiences in charge of federal civilians regarding stress and absenteeism working under the leadership of military leaders at Fort Belvoir, Virginia.

Expanding to other services will define trends on a larger scale outside of the Army to include Navy, Coast Guard, Marines, and Air Force Sergeants or officers in charge of federal employees who are similarly situated in a global perspective. For leaders to be successful in the future, individuals and organizations must expand their knowledge and understanding of leadership and how it is practiced. Strong leadership is important to the success of organizations to foster a more inclusive approach to leadership in the 21st century (Hesselbein & Goldsmith, 2006).

Every leader and employee wants an opportunity to advance in his or her career; however, if they are dissatisfied with leadership or unhappy with their job then it is difficult for them to succeed or reach their full potential in a hostile working environment, which could cause stress and absenteeism. A more in-depth analysis of stress and absenteeism from other experiences in the community will support the need for cultural change.

Changing an organization's culture is another area for future research. Changing an organization's culture is not an easy process (Brown, 2011). Culture derives from an organization's shared behaviors and the working relationship that members have developed over time (Brown, 2011). Military and civilian culture carries two different set of rules, regulations, and policies. It is critical for Army sergeants to understand and apply them effectively and fairly in application of his or her duties. The transformation of an organization, consequently, takes much time to be effective (Brown, 2008).

Pettigrew (2000) stated, "Emergent change consists of ongoing accommodations, adaptations, and alterations that produce fundamental change without prior intentions to do so" (237). Organizations must be able to change on continuous bases if they expect to survive and thrive in the 21st century (Medley & Akan, 2008). The results of the study will also benefit military leaders in an effort to develop policies that require mandatory conflict management training for all military leaders who supervises federal employees.

Research shows that how leaders manage conflict in the workplace impacts productivity and outcomes of conflict, for both the individual and the organization (Trudel & Reio, Jr., 2011). Poorly managed conflict or workplace environment will have a negative impact on

the level of frequency of future conflict, which has a direct negative effect of employees' performance, learning, and work productivity (Trudel & Reio, Jr, 2011).

This study contributes to new ideas, and knowledge discovered during the research. The results show how Army sergeants in charge of federal employees' leadership style influences behavior, and affects attitudes, work productivity, quality of life, and absenteeism, which is the driving force for motivating employees. The study also shows how a lack of *effective communication* from military leaders causes a breakdown in communications between employees and his or her leader, which could lead to a stressful environment.

Organizational leaders today want employees who can respect one another in the workplace regardless of the individual ethnicity, age, gender, religion, national origin, disability, or sexual preference. Another benefit of the research study is that it promotes and defines environments that is free of hostile working environment, is considered a healthy working environment, and a sign of good leadership. Good leaders open opportunities for future possibilities for younger leaders to develop and embrace change without any forms of prejudices.

6. Conclusion

The results of the study will benefit the military leadership in fostering an environment that is knowledgeable and trained in supervising federal civilian employees well into the 21st century. Work stress has been identified as a causal agent in several physical, mental, and organizational environments (Ganster & Schaubroeck, 1991). Job stress affects not only individuals, but has cost American industry more than $100 billion annually in absenteeism, loss of productivity, and health issues associated expenses (Hendrix, Spencer, & Gibson, 1994). A strong relationship between Army sergeants and federal civilian employees and followers is critical to the success of the overall mission. It is known that excessive absenteeism in the organization could be expensive (Brown & Lam, 2008). Reducing absenteeism is a goal for many organizations, and the leader should focus on factors that cause individuals to be absent (Brown & Lam, 2008).

"You're a leader only if you have followers, and that always requires the development of relationships— the deeper the relationships, the stronger the potential for leadership" (Maxwell, 2007,). Federal employees have an essential role in supporting the military in sustaining the current fight on global terrorism, and

building a culture that embraces the future of national security. "Culture is the life force of an organization" (Hickman, 2010). "In organizations, much as in society, culture is where the real values and underlying beliefs, practices and behavioral norms, symbols, ceremonies, and customs exist" (Yukl, 2002, p. 24).

The study was valuable for newly appointed Army sergeants who may find themselves thrust to lead federal civilian employees in joint military and diverse civilian organizations. The working environment should be free of stress to minimize health risk and lower the chance of depression, anxiety, suicide by employees, family members, and leaders (Karney & Crown, 2007).

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Research Article

Counterinsurgency Policy in Phase IV of Operation Iraqi Freedom

Gökhan Akçeşme *, Recep Sait Arpat**

* War Colleges Command, Army War College, Yenilevent-34330, İstanbul, Turkey. Tel: +90 212 398-0100,
e-mail: gakcesme@gmail.com;
** War Colleges Command, Army War College, Yenilevent-34330, İstanbul, Turkey. Tel: +90 212 398-0100.
e-mail: recepaarpat@gmail.com

‡ Corresponding Author; Address: Tel: +90 212 398 00 01, e-mail: gakcesme@gmail.com

Abstract- Operation Iraqi Freedom (OIF) was launched on March 20, 2003 to move the regime of Saddam Hussein and help Iraqi people to rebuild a new Iraq. The outcomes of the operations demonstrate that plans and preparations were hastily made and with a lack of contingency plans. The role of civilian agencies working with the new Baghdad regime in the post-war era was not implemented successfully. The post war period's desired end states were not achieved as planned. What were the assumptions of CENTCOM before the OPLAN 1003? What did the counterinsurgency policy rely on? What was the reaction of the Iraqi people against the OIF army? How does this policy affect the desired end state? The aim of this article is to respond to the aforementioned questions. This paper seeks to demonstrate the weaknesses of the counterinsurgency policy pursed in the OIF and the measures taken in wake of the failure. Finally, the lessons learned are described and suggestions are given.

Keywords- Counterinsurgency; Iraq; Operation Iraqi Freedom; OPLAN 1003, Policy.

1. Introduction

The United States (US) Foreign Policy has instigated foreign internal conflicts in its application. The US has participated in efforts meant to stabilize war torn countries and assist them in recovering. Since the end of the Cold War, the US participated in both small wars and engaged in operations that are not involved in war (Forman, 2012). Through such involvement, the US military has encountered smaller contingencies, which involve integration with the civilians. This is a problem as the military preparation involves tactics used in large and advanced technological wars. Whenever the US military responds to a minor emergency, it is compelled to relearn how to manage these smaller contingencies. The wars in countries such as Iraq and Afghanistan have provided insight about whether and how the US should operate in post-

conflict as well as in conflict environments. The two wars found a place in American history books based on the efforts and finances used, the number of military deployments, and the magnitude of the US casualties (Packer, 2005). The US had not experienced loss since the Vietnam War. However, the conflicts demonstrated the challenges the US faced regarding their participation in internal conflicts (Government Printing Office, Beyond Iraq: Repercussions of Iraq Stabilization and Reconstruction Policies, 2003).

Such challenges included the lack of military and civilian coordination, difficulty in achieving strategic success through tactical and operational methods, and the use of shortcuts. This article will therefore analyze whether the United States' presence in Iraq succeeded in stabilizing and reconstructing Iraq in terms of the implementation of its policies. It will focus on Phase IV, which is

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the last period of the military campaign to liberate Iraq. The main phases were as follows: Phase I, preparation for securing regional and international support; Phase II, shaping the battlespace; Phase III, decisive offensive operations; Phase IV, post hostilities (Fontenot et al., 2004).

2. Background Information

Operation Iraqi Freedom (OIF) was a war plan implemented by the US. Popular belief among the policy makers assumed that Iraqi civilians would intervene in the military planning process. The initiation plans for OIF began on November 27, 2001. President George Bush requested the Secretary of Defense Donald Rumsfeld and Commander of United States Central Command (CENTCOM) Tommy Franks to reassess an existing war plan (OPLAN 1003) against Iraq. In a few days' time, Rumsfeld directed Franks to devise a new war plan that included deployment of fewer forces, new technologies, and insights acquired from the operation "Enduring Freedom," which was a seven-week operation undertaken in Afghanistan (Bensahel, 2006).

However, the war plan implemented for OIF proved incapable its purpose. The war plan had many problems in its initial planning and implementation. It made optimistic assumptions and did not have a contingency plan in case of unexpected outcomes. A Government Accountability Office (GAO) analysis observed that the OIF OPLAN did not document risk mitigation strategies in case assumptions were proven wrong. According to a 2006 report by the Joint Center for Operational Analysis, OIF planning did not examine the consequences of assumptions, which contributed to the inability of coalition forces to prevent the breakdown of civil order in Iraq (Reilly et al., 2012).

The plan also depended entirely on the coordination between the military and civilians. It assumed that the Iraqi people would welcome the Americans as their liberators. The assumption was so misguided that they believed that the civilians would even join them in combat when they learned of the intention of the US, which was to remove President Saddam Hussein and his administration from power. The US forces went into Iraq without preparation. "A valid assumption must have three

characteristics according to their publication JP 5-0 Joint Operation as logical, realistic, and essential for the planning to continue" (JP 5-0,2011). As will be demonstrated below, the assumptions were not estimated successfully.

After the fall of Baghdad, there was increased looting, insurgency, and a break down in law and order for which the American forces were not prepared. The US also assumed that after removing the ministers and their advisors, the government would continue functioning. It believed that the ministries had the capability and power to run the government without ministers. This was not the case. Baghdad was the center of all decision-making as the government had a highly centralized structure (Bensahel, 2006). This incorrect evaluation created the breaking point of the Iraqi state and signaled the beginning of Phase IV of OIF. In planning Phase IV, US policy makers did not contemplate the presence of insurgents and paramilitary forces. The rebuilding of society in Phase IV became a difficult task since it required a non-linear approach instead of a linear progression. The military responsibility in Phase IV was the building of social institutions. However, the militaries' linear approach in decision-making proved to be a hindrance to rebuilding society.

In an operation planning process, the US military employs an approach that involves three levels: strategic, operational, and tactical.

The strategic level entails the stage in which the nation determines its national security goals and utilizes the available resources to complete such goals. The operational level involves the accomplishment of strategic objectives through campaigns in the operational areas. The tactical level of war entails the utilization of units and troops in combat and converting the combat power to successful engagements. In making decisions, the military therefore has to determine the purpose of the action. The military also predetermines the methods of achieving such ends. Lastly, the military determines the means or resources (Kem, 2005).

One of the main goals in Phase IV was the establishment of the rule of law and the

construction of institutions such as schools and hospitals that ordered society.

In light of this information, it is clear that the civilian aspect was the missing in the plan. The operational art was not designed thoroughly. Though the war plan to remove Saddam from office was brilliant, it had no contingency plan and therefore peace planning became a difficult task. Two years after the US invaded Iraq, the contrast between what was expected and what occurred was evident. For example, before the invasion, the Pentagon planners assumed that as few as 35,000 troops would be involved in the invasion in 2003. However, because of the increased insurgency and lawlessness, 150,000 troops were deployed to Iraq by the end of 2005 (Tucker and Hendrickson, 2005).

3. Counterinsurgency policy in Iraq

With the removal of Saddam Hussein from office in 2003, US policy makers and military leaders were not prepared for what was to come. The US faced increased insurgency in Iraq. The plans set out for Phase IV operations did not anticipate the raging insurgency that the US was about to face. According to some American military officials and outside observers, the US did not anticipate the insurgency threat since it was too gracious in removing Saddam from office. The insurgency came about because of the dissolution of Iraqi military units (Woodward, 2004). Most of the soldiers returned home assuming that their service as soldiers had ended. However, many others continued the resistance and went underground. The insurgencies proved to be a threat to the US campaign as they had a number of advantages such as knowledge of the terrain and home advantage. Additionally, the insurgency had access to explosives and arms (Tucker and Hendrickson, 2005). The insurgents had the ability to attack from unexpected directions. This made the US forces be suspicious of any Iraqi. The main advantage enjoyed by the insurgents was their ability to make the American military responses antagonistic to the interests of the indigenous population. This made any contact with the members of the population to be a source of danger to the military troops. The US forces' own propaganda relating to the motivation of the

insurgents misled them. They failed to recognize the motivational factors as the nationalistic and religious revulsions and revenge following the death of fellow Iraqis in the hands of the Americans. The Americans believed that Iraqi people fought against them, as they were loyal to Saddam or Al-Qaeda (Hashim, 2006).

From 2003, the US and Iraqi forces have engaged in armed conflict where the counter insurgents and the insurgents resorted to a deadly learning game. Until 2006, the learning game evolved to a full-scale war. The participants in the war include American and Iraqi security forces against sectarian militia, jihadists, and Sunni Arab insurgents (Metz, 2007). The view of most military officials and policy makers is that the America's engagement in counterinsurgency strategy is inevitable in Iraq. They argue that the counterinsurgency measures are necessary because of the long war waged against the jihadists. In light of this argument, the US needed to put in place an organization as well as a strategy that could undertake counterinsurgency in the region.

The Department of Defense carried out counterinsurgency operations and other irregular operations. The Department of Defense, under the direction of the President, established the Office of Reconstruction and Humanitarian Assistance (ORHA). The ORHA was a civilian-led office that was charged with creating a plan regarding the post-war situation in Iraq (Bowen, 2013). The creation of the ORHA resulted in the military and civilian authorities reporting to a single decision maker, Secretary of Defense Rumsfeld (Bensahel, 2006).

However, things did not go as planned. The plan was that the ORHA would enter Iraq and begin their efforts as soon as the shooting ended (Bensahel, 2006). However, the ORHA was short lived. The Coalition Provisional Authority (CPA) replaced the ORHA. By replacing the ORHA, a shift in the US policy directed towards post-war Iraq occurred. In the first months, CPA managed to work closely with the Baghdad ministries. However, the office was understaffed and plagued by constraints. The military had taken upon itself to begin local reconstruction activities in an effort to establish connections with the local inhabitants

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(Rathmell, 2005). The creation of the CPA meant that the military would finally be relieved of these duties.

However, because of the constraints, understaffing, and increased insurgency, only a handful of the CPA officials left Baghdad. The US Central Command (CENTCOM) sent more military police to address the issue. Most of the military officials felt that the use of combat troops for civic activities was ineffective. They felt that inadequate training did not allow them to perform such activities. This triggered the heated debate on whether the counterinsurgency policy was doing more harm than good. This was a result of the realization that even though counterinsurgency operations made some Iraqis feel safe and deterred some insurgents, it also antagonized other Iraqis. The Americans could not rely upon the Iraqi people in securing the country. The policy makers deployed more units to carry out patrols in Baghdad. More troops were deployed to the Sunni Arab areas (Metz, 2007).

CENTCOM and the Pentagon realized that the Saddam's supporters carried out most of the insurgent activities and the violence. The military personnel took a more aggressive stance. The US troops attacked the Sunni triangle by carrying out a series of raids and sweeps. The operation resulted in the capture and death of many insurgents. However, this had a negative effect on the public, as their actions turned the inhabitants against the US troops. In capturing and killing insurgents, Iraqi public support to the US degraded. The counterinsurgency became a vicious cycle whereby the civilians turned against the military and the military viewed every civilian as a potential enemy (Phillips, 2005).

The hostility of the Iraqi people increased and in turn, the hostility of the troops increased. The anger from the American troops resulted from losing friends and comrades in combat. In the beginning of the counterinsurgency campaign, the US military employed a velvet glove approach instead of a mailed fist approach. The velvet fist approach employed tactics that placed emphasis on the gathering of intelligence, winning the support of the inhabitants, and the use of friendly persuasion. However, a major section of the Iraqi public did not acknowledge the velvet approach. Most of the inhabitants associated the American occupation with their suffering. Additionally, the presence of foreign jihadists fueled the fire. They converted the conflict from a political conflict to a spiritual struggle.

4. Weakness of Counterinsurgency Policy

The counter insurgency efforts in Iraq had a number of weaknesses. The US used flawed strategic assumptions and did not plan adequately for an insurgency. The transfer of power to the new Interim Iraqi Government marked the end of the political phase of the US occupation in Iraq. Though the transfer of power signified a hopeful departure for the Iraqis, the country was still plagued with problems. Such problems included endemic violence, an economy that lacked functionality, a state that was shattered, and a decimated society. The situation today is that the Bush's administration's promises to the Iraqis fell short. This came about because of the increased miscalculations throughout America's occupation in Iraq. Additionally, killings continued to take place where the victims were Iraqis, Americans, and other foreigners.

One of the weaknesses in the fight against the insurgency was related to security. In post-war Iraq, the Bush administration was reluctant in committing additional forces in ensuring law and order. Washington had already received warning from military leaders who suggested that security needed hundreds of thousands of troops. The required number of troops was approximately half a million; however, the troops deployed to Iraq were less than a third of that number. Every call made to the Secretary of Defense Donald Rumsfeld related to deploying more military person fell on deaf ears (Diamond, 2004). The Secretary of Defense made it clear that deploying additional military personnel to Iraq was an unwelcome idea.

Another weakness of the counterinsurgency was the false hope around the top of the chain of command. Before the counterinsurgency, there was a misled assumption that with the removal of Saddam from power, the US would capitalize the good will by returning the country to the Iraqi people to create a democratic state. The number of

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troops needed at first would be few; but after a year, the number of troops would reduce to a few tens of thousands. However, with the dawn of the insurgency, the assumptions collapsed. The insurgents looted and sabotaged Iraq and the US troops stood by feeling helpless as the insurgents outnumbered them and they were not prepared to deal with insurgency. Even at this time, the Bush administration did not sanction sending more troops. They stood upon the misled belief that the insurgents defeat could occur in the near future (Diamond, 2004). Initially in the war against the insurgency, counterinsurgency measures dictated that the Americans could not escalate their efforts. This indicated to the insurgents and their supporters that their willingness to impose harm outweighs the Americans' ability to impose harm on them. Another weakness of the counterinsurgency was that American policy makers, in attempting transformation, did not establish security.

Additionally, the US policy makers also linked the insurgency in Iraq to the global war on terror. This distorted and clouded their judgment relative to the formation of a strategy to deal with the insurgency. They employed a strategy of slow destruction or attrition (Metz, 2007). This ultimately did not produce the expected results.

5. Potential Areas of Improvement

In reducing the violence in Iraq, the US should consider changing its strategies and approaches. The existing policies need adjustments. Recently the additional troops have been deployed Iraq to deal with the insurgency. Additionally, the coalition has also used Iraqi forces to deal with the insurgency. This approach involves increasing force levels to a point where the policy makers will witness escalation in the violence. This strategy does not guarantee success in the near future, since 2003 the situation is the same. The US should employ a policy and strategy that reduces violence and ensures the safety and security of Iraq (Oliker et al., 2007).

In terms of the security policies in place, the US should ensure that the Iraqi forces become less sectarian to increase their effectiveness in the war against the insurgency. The Ministry of Interior should undergo thorough reforms since it is

associated with instances of violence. Commissions should be established to vet the security personnel. Members of the vetting commissions should include representatives from each party. There should be thorough investigations related to the specialized police units. The next step would be to disband the units with records of abuse and malpractice. Government funds should not flow to the militia and therefore better financial control must exist. To do this, the US policy makers must establish a system of transparency and oversight. Additionally, joint patrols may reduce the perception of foreign occupation among the Iraqi people. The Iraqi police should respond to violence cases and lead the patrols. An equally stronger justice and prison system should reinforce the efforts of the Iraqi police. The US should fund the Iraq prisons and courts to ensure that the police's efforts are not in vain (Oliker et al., 2007).

For the sake of peace in the region, counterinsurgency measures must employ demobilization, disarmament, and reintegration (DDR) strategies. This strategy will only be effective once the fighting decreases. The US government should collaborate with the Iraqi government in the formulation of a DDR program. When the fighting subsides, the program should target militia members and insurgents. Additionally, they should target redundant government security personnel. The individuals targeted may acquire job training from the DDR program. The program may prove to be an expensive venture. However, the US may provide advice and resources in making it a reality (Hoffman, 2004).

Counterinsurgency efforts should involve exerting maximum pressure on the insurgents relative to their freedom to act. The counterinsurgency operations employed by the US had a tactical approach. It involved conducting door-to-door raids and patrols (Jabar, 2004). This method became counterproductive over time. On the other hand, this confused the law-abiding citizens who did not know what to expect from each side. A counterinsurgency strategy success depends on the achievement of balance between these elements. If the US fails to maintain such balance, the enemy will continue reconstruction as well as

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regeneration constantly (Pirnie and O'Connell, 2008). To do so, the US must have the capability and willingness to apply force in precise and appropriate measure (Smith, 2005). Since the insurgency in Iraq enjoys support from the population, the military cannot defeat it alone. The US also needs to form partnerships with the Iraqi security forces in conducting operations. Additionally, the US should engage in harmonizing training between the US Special Forces and their indigenous counterparts.

6. Conclusion

The US has learned many lessons from its experience in Iraq. Some of the lessons learned include the importance of collaboration with the Iraqi forces in dealing with counterinsurgency. The US has also learned about how to combine military and civil affairs. Additionally, the experience gained in the experience in Iraq indicated to the American agencies and the military that there was need to reshape. The US should also increase its expertise in nation building (Dobbins, 2003). Establishing a department whose primary responsibility involves reconstruction and stabilization can increase the experts in this field. On the other hand, the military must use more time in training its troops on how to deal with the insurgency, especially since it had dealt with a similar problem in Vietnam. From this perspective it is clear that the plans were hastily made.

Another important lesson is the importance of employing realism when devising war plans (Adams, 2006). The politically unrealistic assumptions used in designing the war plans were not aligned with the realities in the ground. The other consideration the US should make involves employing strategic pluralism. Strategic pluralism is an attitude that avoids the belief that "we can do it better next time" and instead employs an attitude that suggests, " we won't do it at all" (Tucker and Hendrickson, 2005). The fact that threats are always unpredictable guides this attitude.

The Americans had to come to a realization that war is a policy instrument. In other words, the only justification to war is its service towards achieving a political aim. The creation of the American war plan that did not accommodate the most important political goal reflected this state of mind. This political goal or aim involved successful reconstruction. The American war plan did not consider or anticipate the challenges the US would face after removing Saddam and his administration from office. America's policy makers who are both military personnel and civilians should move away from the stupendous attitudes of fire and movement. Instead, they should focus on the political achievements that war would accomplish.

Relative to the coalition, the US learned that in every mission they should employ mechanisms that guarantee unity of effort. It is important to establish institutions to deal with the insurgency and other conflicts before the onset of the crisis. The survival and effectiveness depends on its staffing. The experience in Iraq also showed the country the importance of making early plans. The purpose of early planning mechanisms involves challenging assumptions and making adequate contingency plans. Additionally, to align the resources with the set priorities, the planning process must be integrated with the management and resource allocation processes.

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Agent-Based Simulation Model for Profit Maximization

Banu Çalış

* Marmara University, Faculty of Engineering, Industrial Engineering Department,
e-mail: bcalis@marmara.edu.tr

Corresponding Author; Address: Goztepe / Istanbul - Turkey Tel: +90 216 348 02 92, Fax: +90 216 348 02 93,

Abstract- This study considers a single-machine scheduling problem where the objective is to maximize total profit (Pr_{max}). The problem is identified as 1 ││ Pr_{max}. The aim of this study is to develop a profit-based scheduling model using agent-based architecture in order to increase profitability of a single machine manufacturing systems. All objective functions in the literature are based on manufacturing cost. This study shows a new profit based approach to solve single machine scheduling problems. The model is simulated on the hypothetical data and simulation results show that performance of the proposed model is highly acceptable.

1. Introduction

The single machine scheduling problem has been studied by many researchers. Most of them are complex when arrivals of the orders are dynamic. A branch of artificial intelligence, multi-agent architecture provides the ability to respond quickly to dynamic changes. Agent-based technology has recently been used to solve this problem to produce complex collective behavioral patterns. An agent is a hardware or software that can autonomously perform its tasks with a degree of intelligence (Huang and Liao, 2012).

According to Madejski (2007), the agent-based model can be designed in two way, ''physical'' or a ''functional'' decomposition scheme. In the first case, agents represent physical entities (e.g., machine tools, resources, workers) and in the second case, agents represent the functional decomposition approach. In the functional decomposition approach, agents are assigned to some functions (for instance, scheduling, sequencing, material handling) based on some rules aimed at reproducing optimizing behaviors.

In this study, functional decomposition is used to solve single machine scheduling problem and belief-desire-intention architecture (Meirina et al., 2003) is used to define rules of the decision making process depending on the manipulation of data structures.

Scheduling is defined as the allocation of limited resources. Manufacturing scheduling is a difficult problem, especially when it takes place in a dynamic environment. Most scheduling problems are considered to be NP-hard since computation time increases exponentially with problem size.

This paper considers the single machine scheduling problem with a new objective function (Pr_{max}). Aim of this objective is to maximize the total profit. The difference between cost-based approach and profit-based approach could be summarized as instead of minimizing the cost, a profit is maximized by a schedule for the manufacturing orders. Well known objective functions and the proposed Pr_{max} are given in Table 1.

The proposed multi-agent based approach works under a real-time environment and generates feasible and the most profitable schedules using negotiation/bidding mechanisms between agents.

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Table1. Well known objective functions (Adapted from Ross and Corne, 2005)

Performance measure	Symbol	Based On
Maximum total profit	Pr_{max}	Proposed Profit based approach
Maximum complete time	C_{max}	
Mean complete time	$\bar{C}$	
Maximum flow time	F_{max}	
Mean flow time	$\bar{F}$	Cost based approaches in the literature
Maximum lateness	L_{max}	
Mean lateness	$\bar{L}$	
Maximum tardiness	T_{max}	
Mean tardiness	$\bar{T}$	
Number of tardy jobs	NT	
Maximum earliness	E_{max}	

This paper is organized as follows: In Section 2, a brief review of the previous research on agent-based architecture and the single machine scheduling problem is given. In Section 3, the problem is introduced and formulated. In Section 4, test results of the problems are shown. And the last section includes conclusions and future research of the study.

2. Literature Review

The first use of agents in manufacturing scheduling and factory control was studied by Shaw (1983). He proposed that a manufacturing cell can subcontract work to other cells through a bidding mechanism. According to Wooldridge and Jennings (1995) an agent interacts with its environment depending on features listed below;

Independence: Agent has ability to act without direct human beings or another device

Social ability: Agents use a communication language to satisfy communication and coordination between agents.

Re-activeness: Agents answer to perceived actions in a precise way

Pro-activeness: Agents decides itself for the necessary activities.

Sousa and Ramos (1999) propose an advance model which is involve also job agents. In this study resource agent has an ability to send fault messages to job agents. Cowling, Ouelhadj, and Petrovic (2004) presented an adaptation of agent-based scheduling to dynamic scheduling in steel production process,

Liao and Chen (2003) considered single-machine scheduling under periodic maintenance and non-reusable jobs. Walker et al. (2005) studied on dynamic and responsive scheduler using multi agent architecture for the holonic manufacturing system.

Single machine total weighted number of tardy jobs problem was considered by Cheng et al. (2006). In their study each agent considered the same objective function. Mosheiov and Yovel. (2006) studied a generalized version of minimizing the total earliness tardiness problem. The objective is defined as minimizing the total cost.

Agnetis and Pacciarelli (2007) presented single machine scheduling problems where the objective functions are total weighted completion, maximum of regular functions. The single-machine minimize makespan problem is considered with periodic maintenance by Ji et al (2007).

Janiak and Rudek (2008) considered minimizing the number of late jobs with a positional learning. They proved that the problem is strongly NP-hard. Eren (2009) showed that minimizing the total weighted completion time problem and developed a non-linear mathematical programming model. Zhang et al. (2009) presented the single-machine scheduling problems under release dates constraint.

Single machine minimize the total cost problem is studied Nong et al. (2011), two-agent architecture is used in their study. Yinet al. (2012) considered single machine scheduling problem with two agents under release dates constraint. The objective is to minimize the tardiness.

Wu, et al. (2013) considered two-agent single-machine scheduling problem under ready time constraint. Their objective was minimizing total completion time. Single-machine scheduling with two synergetic agents was studied under non-preemptive jobs by Yu et al. (2013). Their study seeks to minimize a regular objective function that depends on the completion times of its own jobs only.

A new scheduling model was proposed by Cheng (2014) that considered both two-agents; minimizing total (weighted) earliness cost of one agent, under an upper bound on the maximum earliness cost of the other agent.

There are numerous studies on single machine scheduling problem. A brief summary is stated in this section. As a result of this section total profit maximization was not observed, which define the agent's decision making processes. The next section provides detail information about the proposed model.

3. Profit Based Scheduling Model

The single machine scheduling problem is consists of a single machine to process n jobs. In this study, the objective function is defined as the maximization of the profit of processing these n jobs. Model parameters, sets, and variables are;

J : set of scheduled operations,

J^d : candidate jobs to be scheduled at time t,

J^c : set of unscheduled jobs at time t

t : scheduling time

P_j : unit processing time of job j

d_j : due date of job j

C_j : completion time of job j

Pr_j : unit profit of job j

Dm_j: amount of demand of job j

PR_i : profit of job j

The problem is identified as $1 \mid \mid Pr_{max}$. The jobs may not be preempted and each job j is characterized by its processing time P_j, its due date d_j and its profit value Pr_j.

The model was constructed with n independent job to be processed on a single machine under the time constraint. The proposed model is included a set of three integrated agent based modules; Order Analysis Agent (OAA), Profit Analysis Agent (PAA), and Reporting and Scheduling Agent (RSA). Figure 1 shows the relationship of these agents where the arcs are indicating the work flow.
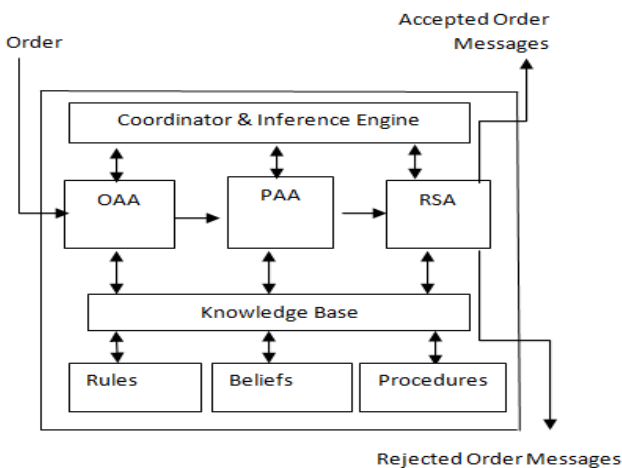

Fig.1. Component of PBSM

Agent architectures of the proposed model are detailed in each respective section

3.1. Order Analysis Agent (OAA)

The primary task of OAA is to identify predefined set of order and support the assessment with respect to the decision of whether those orders are acceptable or not.

In this study, customer orders are generated from a discrete uniform distribution. After random number generation process, OAA uses three analysis methods for decision of accepting or rejecting of an order and related production sequence of the orders. The first analysis technique is "Model-1: Unit Profit Model (UPM)" which is defined as the most profitable product is produced first.

The business rules of UPM are;

➢ Prepare a list of orders with respective order quantity;

➢ Compute the needed production time of each order;

➢ Elaborate unit profits of each order;

➢ Define most profitable order list from top to bottom; and

➢ Generate a production sequence to report.

The second analysis technique is "Model 2: Daily Profit Model (DPM)" which considers that the most daily profitable job is selected to schedule first.

The business rules of DPM are;

➢ Prepare a list of orders with respective order quantity;

➢ Compute the needed production time of each order;

➢ Elaborate daily profits of each order depends on machine capacity;

➢ Define most profitable order list from top to bottom; and

➢ Generate a production sequence to report.

And the last analysis technique is "Model 3: Total Profit Model (TPM)" where the most profitable order is processed.

The business rules of DPM are;

➢ Prepare a list of orders with respective order quantity;

➢ Compute the needed production time of each order;

➢ Elaborate total profits of each order depends on order quantity;

➢ Define most profitable order list from top to bottom; and

➢ Generate a production sequence to report.

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Figure 2 shows OAA components where each model represents a different analysis approach.

OAA engine defines the 3 different production sequence of orders depends on 3 different models explained above. This information is transmitted to Profit Analysis Agent to make profit analysis.
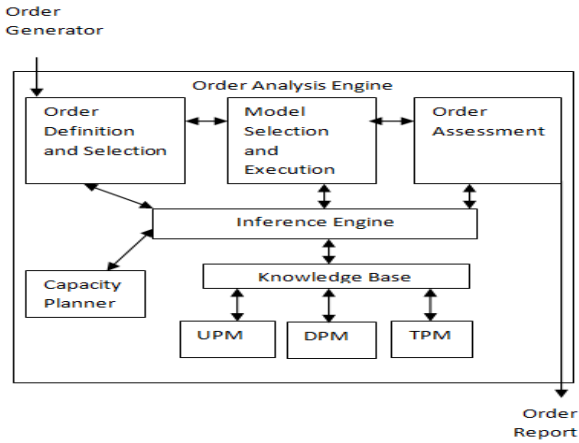

Fig.2. Order Analysis Agent Architecture

3.2. Profit Analysis Agent (PAA)

The PAA is responsible for the selection of most profitable sequence of three different models. After an order report is prepared by OAA, this information is transmitted to PAA. Negotiation is a key function of PAA which satisfies interaction in groups of agents that enables mutual agreement including belief, goal, or plan. In this study, the simplest case of negotiation is used which could be define as the structure and contents of the agreement are fixed. For that purpose the calculation of the accepted order' profits for three sequence was elaborated by PAA. The agents' reasoning models provide the decision making which model attempt to achieve objectives.

The business Rules of PAA are;

➢ Calculate total profits of 3 types order sequence (UPM, DPM and TPM);

➢ Select the most profitable sequence to schedule manufacturing;

➢ If total profits of the three models are equal send this information to order elaborator ;

➢ The order elaborator selects the technique that has the maximum number of orders in it to satisfy more customers and sends the selected profit model schedule to scheduler; and

➢ When all total profit values and number of accepted orders are same for each 3 models. Select the model randomly.

After the analysis is complete, PAA sends related information (selected model and related production schedule) to Scheduling Agent for the preparation of a job order and sends it to the Reporting Agent for prepare a form to inform customers. Figure 3 shows its components where each component represents model selection and amount determination.
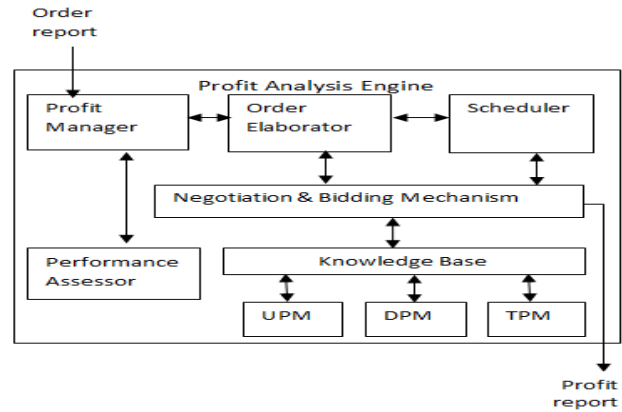
Fig.3. Profit Analysis Agent Architecture

3.3. Reporting and Scheduling Agent (RSA)

The RSA is responsible to prepare preparing a form indicating the status of order acceptance or rejection messages as well as due dates for accepted orders to inform customers. Scheduling engine of RSA prepares a job order form including accepted jobs, jobs' schedule and related due dates.

The business rules of RSA are;

➢ Prepare job order list for accepted orders;

➢ Check scheduled delivery date of orders and provide an approval form;

➢ If there is a late job send this information to Coordinator & Inference Engine to start new scheduling process; and

➢ Prepare an order acceptance report to send customers including delivery date or rejection of given order.

Figure 4 shows the architecture of RSA

This section introduced a prototype profit based scheduling model based on agent based architecture. The model execution of the proposed model is outlined in the next section.
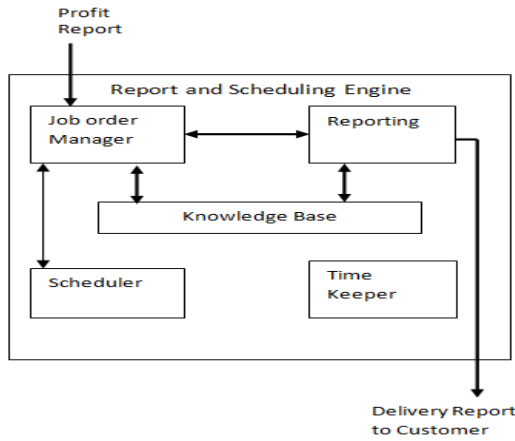
Fig.4. Reporting and scheduling agent architecture

4. Test Results

Computational example and simulation test results are explained below.

4.1. Algorithm Test Results

In this section, implementation of the proposed model is presented. Simulation technique is used to see effectiveness of the proposed model.

Model assumptions are;

1. In order to measure the capability of reference model a hypothetic database is constructed which is explained in section 3.1

2. Simulation parameters are; The problem considers n independent jobs (j=1,2,…,n) on a single machine to maximize total profit. There are no precedence constraints between jobs and each job has a nonnegative due date d_j ($d_j \geq 0$). The machine is continuously available and can process one job at a time.

   a. P_j is generated from a discrete uniform distribution between 5 and 250 (in terms of minutes)

   b. d_j is generated from a discrete uniform distribution between 1 and 9 (in terms of days)

   c. Dm_j is generated from a discrete uniform distribution between 5 and 900 units

   d. Pr_j is is generated from a discrete uniform distribution between 5 and 90

3. The experimental study is conducted in MS Excel

4. Number of job sets is restricted to 9 due to the macro capacity limitations of MS Excel

5. There could be more than one order which includes same type of job

6. An order must include only one type of job

A hypothetical example including the Unit Profit Model, Daily Profit Model, Total Profit Model and Opportunity Cost values calculated after 20 simulation runs (Table 2). As can be seen from the Table 2, results of each trial are different than others depending on random orders and random due dates. As a result of 20 trials, it can be said that $126.008 will be lost that is the opportunity cost (if comparison of the three models is not used and if the lowest profit techniques were selected, the company will lose this amount of money) of the manufacturing company.

The reference model was run 100 times and the results were recorded. The success frequency of each profit model is summarized in Figure 5.

Table 2. Results of the first 20 trials

TRIALS	UPM	DPM	TPM	Opportunity Cost
1	48456	48456	39456	9000(*)
2	42853	42853	42853	0
3	45463	45463	44983	480
4	37690	43225	37690	5535
5	42380	51292	46572	8912
6	52260	52260	52260	0
7	30438	30438	30438	0
8	39805	47151	39805	7346
9	31926	31926	31926	0
10	29340	29340	43405	14065
11	38765	49440	48890	10675
12	42747	42747	42747	0
13	32741	17831	32741	14910
14	41530	41070	41070	460
15	40150	44500	44500	4350
16	30730	28094	32074	3980
17	38235	48003	54258	16023
18	42400	24428	37000	17972
19	40270	51610	51610	11340
20	30027	30987	30987	960
Total	778206	801114	825265	**126008**

(*)An example calculation of Opportunity Cost for trial 1;
= Maximum profit – Minimum profit
= 48456 – 39 456 = $ 9000

Figure 5 shows that unit profit model gives better solution than others. 57 times of 100 trials, total profit of UPM model gives the most profitable solution for the Company. Contrary to initial expectations, TPM gives only 17 times best profit than others.
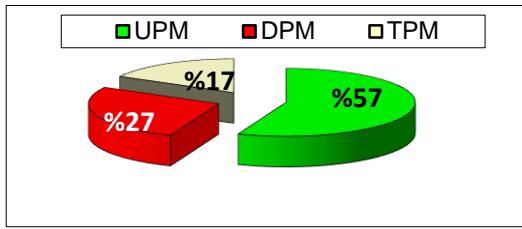
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Calıs, B., (2016). Agent-Based Simulation Model for Profit Maximization, Journal of Military and Information Science, Vol4(1),26-33.

Fig. 5. Frequency of the selected profit models

1. Unit Profit Model: % 57

2. Daily Profit Model: % 27

3. Total Profit Model: % 17

4.2. Benchmark Problem Test Results

In this section, proposed algorithm is tested with well-known scheduling rule WSPT (weighted shortest processing rule due to its superior performance on cost type objective. WSPT rule is modified to be used on maximization problem. This rule sort jobs by increasing p_j / w_j-values.

In this study w_j is defined as unit profit. An easy example and test results are shown in Table 3.

Table 3. Sample test data

Features	Jobs								
	A	B	C	D	E	F	G	H	I
Dm_j	661	348	744	232	660	530	613	612	831
d_j	8	2	5	4	2	4	6	1	1
Pr_j	50	45	12	55	15	20	10	60	5
p_j	210	150	50	250	70	110	46	190	35
p_j/w_j	4,20	3,33	4,17	4,55	4,67	5,50	4,60	3,17	7,00

Depends on WSPT rule, jobs' sequence and total profit value of the sample data set is given in Table 4.

Table 4. Jobs' Sequence depends on WSPT rule

Sequence	Start	Finish	Decision
I	0	29085	0
F	0	58300	1
E	58300	104500	0
G	58300	86498	1
D	86498	144498	0
A	86498	225308	1
C	225308	262508	0
B	225308	277508	0
H	225308	341588	0

Total Profit : 49780 $

Calıs, B., (2016). Agent-Based Simulation Model for Profit Maximization, Journal of Military and Information Science, Vol4(1),26-33.

The same sample test data is scheduled depends on UPM, DPM and DPM algorithm and results are shown in Table 5 to 7 respectively

Table 5. Jobs' Sequence depends on UPM model

Sequence	Start	Finish	Decision
H	0	116280	0
D	0	58000	1
A	58000	196810	1
B	196810	249010	0
F	196810	255110	0
E	196810	243010	0
C	196810	234010	0
G	196810	225008	0
I	196810	313090	0

Total Profit : 45810 $

Table 6. Jobs' Sequence depends on DPM model

Sequence	Start	Finish	Decision
H	0	116280	0
B	0	52200	1
C	52200	89400	1
A	89400	228210	1
D	228210	286210	0
G	228210	256408	0
E	228210	274410	0
F	228210	286510	0
I	286510	315595	0

Total Profit : 57638 $

Table 7. Jobs' Sequence depends on TPM model

Order	Start	Finish	
D	0	58000	1
F	58000	116300	0
B	58000	110200	0
G	58000	86198	1
C	86198	123398	1
E	123398	169598	0
A	123398	262208	0
H	123398	239678	0
I	123398	152483	0

Total Profit : 27818 $

For this example the highest profit is *$57638 which is calculated from DPM whereas WSPT rule result is $45810.*

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From this point, the proposed agent based model and WSPT rule was simulated on 50 randomly generated test problems. The experimental results showed that the proposed model yielded better results in 40 out of 50 problems. Twenty of the results are presented in the Table 8.

Table 8. Comparison between WSPT rule and proposed algorithm depending on objective function Pr_{max}

| TRIALS | WSPT | Proposed Model | | | Difference btw WSPT and best Algorithm results |
		UPM	DPM	DPM	
1	55887	**63255**	50715	50715	7368
2	21501	**35571**	25586	35571	14070
3	28210	**62425**	62425	41980	34215
4	**84658**	69900	58845	58845	-14758
5	51575	**55310**	57890	43790	3735
6	21340	**49585**	33985	49585	28245
7	42797	**51422**	51007	51007	8625
8	28368	39065	37703	**50850**	22482
9	35761	**56901**	56901	56901	21140
10	29150	23910	**34362**	23910	5212
11	**42802**	38522	29002	38522	-4280
12	28415	63720	56480	**65780**	37365
13	39295	**50100**	42791	45260	10805
14	20552	49755	**55227**	50885	34675
15	28795	**49640**	18290	49640	20845
16	**53840**	47324	47324	45209	-6516
17	43485	38265	48495	**48495**	5010
18	28625	**40048**	40048	40048	11423
19	25352	46915	45610	**52500**	27148
20	26083	**38345**	2003	31170	12262
Total					**279071**

As can be seen in the Table 8, the proposed model produces better solution than WSPT rule on average and total opportunity cost was calculated as $279,071 for 20 trial.

4. Conclusions

In the reference model, a profit based scheduling algorithm is prepared and run for a small and non-complex system. The proposed model could maximize the profit of the given orders depending on three profit techniques under the time constraints. MS Excel was selected to execute the model. The experimental studies showed that the UPM model was the most selected technique in the proposed model. Also the proposed model was compared to the WSPT rule due to its superior performance on cost type objective. WSPT rule is modified to be used on maximization problem. Test results show that proposed model outperforms WSPT rule.

For the short execution time, the applicability of the reference model is very high. It is seen that if there is an increase in the number of constraints or number of machines MS Excel will not be an appropriate tool to solve this problem because of the limited number of if-then loops. This study shows that the profit based schedule depending on agent-based algorithm produces effective solutions for companies. Future research may consider studying the problem in the multi-machine environment or extending to the multi-objective optimization.

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Operational Criteria Evaluation for Collaboration of Innovative SMEs

İrem Düzdar*‡, Gülgün Kayakutlu**, Bahar Sennaroğlu***

* Department of Industrial Engineering, Faculty of Engineering and Architecture, İstanbul Arel University, İstanbul, Turkey
**Department of Industrial Engineering, Faculty of Management, İstanbul Technical University, İstanbul, Turkey
*** Department of Industrial Engineering, Faculty of Engineering, Marmara University, İstanbul, Turkey

‡ Corresponding Author; Address: İstanbul Arel University, Tepekent, 34537 İstanbul, Türkiye Tel: +90 850 850 2735 e-mail:
iremduzdar@gmail.com

Abstract- SMEs should organize alliances with universities or other research organizations, global business companies, and other SMEs. Each type of alliance has specific risk and success criteria to be studied. SMEs need to construct successful alliances in order to have sustainable business in a competitive environment. Pre-analysis of the path for successful alliances will lead to improvements in innovative power. This study attempts to perform qualitative analysis of the SME alliances in order to express the criteria supporting the success in innovation. In this empirical study, the survey results will be extracted by literature taxonomy to categorize criteria of innovation success. These results will be analyzed by the Analytic Hierarchy Process to prioritize the innovation criteria to help any SME or large business to reduce risks in future alliances. This study will allow structuring strategic decisions based on operational criteria.

Keywords- Analytic Hierarchy Process, Innovation, Taxonomy

1. Introduction

The Organization for Economic Co-operation and Development (OECD) has defined innovation as "the implementation of a new or significantly improved product or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (OECD, 2009). Competitive market conditions are forcing Small and Medium Sized Enterprises (SMEs) to cooperate for innovation, but the presence of risks in the case of defining the route for success is an undeniable fact for collaborating SMEs. The stated strategic decisions of alliances must be powered by the association rules directed at innovative synergy. Innovative collaboration can be defined as cooperative arrangements engaging companies, universities, and government agencies and laboratories in various combinations to pool resources in pursuit of a shared research and development (R&D) objective (Block and Keller, 2009).

Various items that have common features can be categorized or codified into groups or clusters by taxonomies (De Jong and Marsili, 2006). In other words the reviews can be categorized by taxonomies in

the base of their principal specifications (Cooper, 1982). The literature taxonomy is used for innovation collaboration factors in SMEs. In this context it is observed that the operational, managerial, financial, and technological elements of innovation need to be kept going for a long time. It is observed that there are many operational factors that are focused on the value chain as primary process for innovation as the result of the literature analysis (Poggel and Schönwetter, 2010; Singh et al., 2008; Hughes and Wood, 2000).

In this study, effective factors described by taxonomy were determined by the group decision technique. The priorities of these operational factors are evaluated using the Analytic Hierarchy Process (AHP). Based on these priorities, SMEs can define new strategies to have a competitive advantage for collaborative innovation.

2. Methodology

The most common methods of Multi Attribute Decision Making (MADM) problems are the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), AHP, and outranking. The Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE) is one of the widely used

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outranking techniques (Bozbura et al., 2007; Yoon and Hwang, 1995).

Feng et al. (2011) used an integrated method that includes AHP, a scoring method, and weighted geometric averaging method for the selection of collaborative innovation research teams (Feng, 2011). To evaluate the inclinations and choices of the stakeholders, a specific AHP model application is used by Álvarez et al. (2013) in a distinctive social infrastructure projects.

The theory of quantifiable and intangible criteria evaluation, AHP, serves as a very useful method for Multiple Criteria Decision Making (MCDM) problems, which deal with selections and prioritization. AHP can be used to solve problems stemming from investment to resource allocation and organization planning including politics, economics, social, marketing, and management areas (Saaty and Vargas, 1994).

Assuming that we are dealing with n criteria at a given hierarchy, the procedure creates an n×n pairwise comparison matrix, **A**. The pairwise comparison is done as the criterion in row i (i=1,2,…,n) is leveled relative to each of the criteria denoted by the n columns. Letting a_{ij} define the element (i,j) of the matrix **A**, AHP uses a discrete scale from 1 to 9 for pairwise comparisons (Figure 1). For consistency, $a_{ij} = k$ automatically means that $a_{ji} = 1/k$. All the diagonal elements a_{ii} of the comparison matrix **A** equal 1.

Therefore, when n criteria are being compared, n(n−1)/2 pairwise comparisons are required to complete the matrix **A** (Saaty, 1980).

Likert-type or frequency scales use fixed answer formats and are prepared for rating attitudes or ideas. These ranked measures rate the levels of agreement/disagreement (McLeod, 2008).

1	equal importance
3	moderate importance of one over another
5	strong or essential importance
7	very strong or demonstrated importance
9	extreme importance
2,4,6,8	intermediate values
Use reciprocals for inverse comparisons	

Fig. 1. AHP pairwise comparison scale (McLeod, 2008).

Consistency proves that the decision maker is showing coherent judgment in specifying the pairwise comparison of the criteria or alternatives.

Mathematically, a comparison matrix A is consistent if $a_{ij}\ a_{jk} = a_{ik}$, for all i,j, and k. This property implies that all the columns (and rows) of A to be linearly dependent. The columns of any 2×2 comparison matrix are dependent, and hence a 2×2 matrix is always consistent.

Given that human thinking is the basis for generating these matrices, some degree of inconsistency is expected and should be tolerated, provided that it is not unreasonable. To measure the consistency to see whether or not it is reasonable, the consistency ratio (CR) is used. Given **w** is the column vector of the relative weights w_i, *i=1,2,…,n,* **A** is said to be consistent if, and only if,

$$\mathbf{A}\mathbf{w} = n\mathbf{w} \tag{1}$$

For the case where **A** is inconsistent, the relative weight, w_i, is approximated by the average of the n elements of row i in the normalized matrix N.

Letting $\overline{\mathbf{w}}$ be the computed estimate, it can be shown that the closer n_{max} to n, the more consistent the comparison matrix **A**.

$$\mathbf{A}\overline{\mathbf{w}} = n_{max}\overline{\mathbf{w}} \quad , n_{max} \geq n \tag{2}$$

The value of n_{max} is computed from $\mathbf{A}\overline{\mathbf{w}} = n_{max}\overline{\mathbf{w}}$ by observing that the ith equation is (Taha, 2003)

$$\sum_{j=1}^{n} a_{ij}\overline{w}_j = n_{max}\overline{w}_i \quad , i = 1, 2, ..., n \tag{3}$$

$$\sum_{i=1}^{n}\left(\sum_{j=1}^{n} a_{ij}\overline{w}_j\right) = n_{max}\sum_{i=1}^{n}\overline{w}_i = n_{max} \quad \text{given } \sum_{i=1}^{n}\overline{w}_i = 1 \tag{4}$$

This means that the value of n_{max} can be determined by first computing the column vector $\mathbf{A}\overline{\mathbf{w}}$ and then summing its elements (Taha, 2003).

CI : Consistency index of A

RI : Random consistency index of A

CR : Consistency ratio of A

$$CI = \frac{n_{max} - n}{n - 1} \tag{5}$$

$$RI = \frac{1.98(n - 2)}{n} \tag{6}$$

$$CR = \frac{CI}{RI} \tag{7}$$

If CR is less than or equal to 0.1, then the level of inconsistency is acceptable. Otherwise, the inconsistency in **A** is high and the decision maker is advised to revise the elements a$_{ij}$ of A to realize a more consistent matrix (Saaty, 1980).

3. Application and Results

The criteria derived from the literature review, that affect innovation on the basis of the operation is classified by knowledge. The 'Operational' group covers Operational Management, Processes Style, Production & Manufacturing Style, Service Style, Outsourcing Experience, Demand & Supply Management, Inventory Management, Quality Management, Design Operations and, Sales Management. Design Operations, Demand & Supply Management, and Production & Manufacturing Style are frequent in operational criteria (Table 1).

Table 1. Operational criteria frequency

Operational criteria	Number of frequency
Operational Management	3
Processes Style	3
Production & Manufacturing Style	7
Service Style	4
Outsourcing Experience	3
Demand & Supply Management	7
Inventory Management	1
Quality Management	3
Design Operations	8
Sales Management	1
Total	**40**

The factors shown in Table 1 were evaluated by five experts with AHP pairwise comparison scale. The geometric mean technique was applied to these evaluations for the group decision. The geometric mean is "the nth root product of n numbers" and can be calculated by using the following formula:

$$G = \sqrt[n]{x_1 \, x_2 \ldots x_n} \tag{8}$$

AHP technique was used to determine the relative importance of operational criteria. It was observed that inconsistency was at an acceptable level. The priorities of operational criteria according to their weights are seen in Table 2.

Table 2. Weights for operational criteria

Criterion	Priority
Design Operations	0.161
Demand & Supply Management	0.155
Exportation	0.112
Inventory Management	0.095
Operational Management	0.075
Marketing Activities	0.073
Working Conditions	0.068
Employment Rate	0.062
Production & Manufacturing Style	0.048
Number of Executives	0.040
Quality Management	0.030
Outsourcing Experience	0.029
Service Style	0.024
Sales Management	0.021

4. Conclusion

Design Operations and Demand & Supply Management are critical for the operational criteria. Therefore, achieving high performance in these two sub-criteria will bring competitive advantage to SMEs for innovation collaboration. These two influencers are the most important factors to distinguish the SMEs for innovation collaboration. The SMEs that have less experience in exportation because of their economies of scale will prefer to collaborate with the successful alliances in exportation for innovation. Among the other operational criteria, marketing activities have intermediate importance and sales management has minimum importance.

It must be emphasized that the criteria related to human resources have intermediate importance. This may be recognized as one of the priorities of collaborators for innovation.

As a further study, the operational criteria derived from the literature taxonomy can be compared with the other grouped criteria generated in the same manner.

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A Heuristic Approach for a Shelf Space Allocation Problem

A. Hande Erol Bingüler *‡, Serol Bulkan**, Mustafa Ağaoğlu***

* Department of Industrial Engineering, Marmara University, Institute for Graduate Studies in Pure and Applied Sciences, Göztepe 34722, Istanbul, Turkey, hande.erol@marmara.edu.tr
** Department of Industrial Engineering, Marmara University, Faculty of Engineering, Göztepe 34722, Istanbul, Turkey, sbulkan@marmara.edu.tr
*** Department of Computer Engineering, Marmara University, Faculty of Engineering, Göztepe 34722, Istanbul, Turkey, agaoglu@marmara.edu.tr

‡ Corresponding Author; Address: Tel: +90 216 414 05 45 Fax: +90 216 550 52 13, e-mail: hande.erol@marmara.edu.tr

Abstract- A shelf space allocation problem (SSAP) is a special form of multi-constraint knapsack problem. The main difference between a knapsack problem and a SSAP is that a knapsack problem has only capacity constraints. Commercial space management systems use many different heuristic approaches for allocating shelf space due to the NP-hard complexity of the SSAP. These heuristics are usually based on simple intuitive rules that could be easily used in practice to implement shelf space allocation decisions. This paper develops a new heuristic to obtain a good allocation of shelf space for different products in order to increase profitability under different constraints such as limited shelf space and elasticity factors.

Keywords- Evolutionary algorithms; heuristic methods; shelf space allocation problem.

1. Introduction

The knapsack problem is a combinatorial optimization problem. Given a set of items, each with a mass and a value, the goal is to determine how many of items to include in collection so that the total weight can be compared with a given capacity and the total value is as high as possible. Different knapsack problems exist in combinatorics, applied mathematics, and optimization.

The knapsack problem has been studied since 1897. Tobias Dantzig was the first researcher that referred to this problem. Dantzig suggested the name that is obtained in myths before a mathematical problem is fully defined. For all knapsack problems, capable reduction algorithms have been proposed that permit one to fix numerous decision variables for objective functions (Pisinger, 1995). There are many variations of knapsack problems, such as multi-objective knapsack problem, multidimensional knapsack problem, quadratic knapsack problems, and subset sum problem.

The multidimensional knapsack problem is similar to the bin packing problem. In this problem, a subset of items can be chosen to be placed in a bin so that all the items have to be packed in the minimum number of bins. The concept is that the items have multiple dimensions. This variation is apparent in many problems in scheduling/loading in Operations Research (OR) and polynomial-time approximation schemes.

Due to the NP-hard computational complexity of bin packing problems, optimal solutions to the large size instances cannot be obtained. To solve these problems, new heuristics have been developed such as first fit algorithm, tabu search algorithm, and genetic algorithm. There are certain similarities between bin packing problems and parallel machine scheduling problems where the objective is the minimization of the make span.

The shelf space allocation problem (SSAP) was then also viewed as a two-dimensional packing problem which was studied by different researchers. Gilmore and Gomory proposed the first model for two-dimensional packing problems, by modifying their column generation approach for one-dimensional packing problems (Gilmore and Gomory, 1961). Beasley also worked on bin packing problems and

formulated an Integer Linear Programming (ILP) model for two-dimensional packing problems (Beasley, 1985). Hadjiconstantinou and Christofides developed a similar model for this kind of problem (Hadjiconstantinou and Christofides, 1995). Fekete and Schepers studied a new bin packing problem based on graph theory (Fekete and Schepers, 1998), and Lodi et.al. worked on a special kind of problem where the products are packed by levels (Lodi et. al., 2002). Michael and Moffitt showed that item sizes and the capacity of bins span a vector of values, requiring that a feasible or an optimal assignment of the items must satisfy the capacity constraints in all dimensions (Michael and Moffitt, 2013).

In the logistics field, shelf space is one of the main resources to attract more consumers. Effective shelf space management can reduce the inventory levels, and increase wholesaler relationship and customer satisfaction (Fancher, 1991). Shelf space is one of the major resources in retail environment (Hwang et al., 2009). Therefore, the current shelf space management decision is an essential issue in retail operation management.

SSAP is a kind of multi-constraint knapsack problem. SSAP with some policy constraints is not necessary in a knapsack problem. The main assumption of a knapsack problem is that there are one or more dominant resources in the problem such as budget or capacity. Commercial space management systems use many different heuristic approaches for allocating shelf space due to the NP-hard complexity of the SSAP. These heuristics are usually based on simple intuitive rules that could be easily used in practice to obtain shelf space allocation decisions (Zufryden, 1986). The concern for practicability and simplicity for these approaches is on the performance of the space allocation decisions. According to technological growth, the development of optimization approaches to solve SSAP has reached a feasible solution to space management systems stage (Yang, 2001).

In retail store, SSAP is used as a decision problem to attain the best possibly objective using operational constraints. The commercial space management systems generally use relatively simple intuitive rules to develop operating procedures designed easily to make decisions of shelf space allocation in practice (Yang and Chen, 1999). Space allocation affects store profitability through both the demand function considering main and cross space elasticities together, and through the cost function (procurement, carrying and out-of-stock costs) (Corstjens and Doyle, 1981) . Previous studies, usually focused on a limited number of brands and only a few shelves (Dreze et al., 1994).

Hwang et al. proposed a shelf space design mathematical model and item allocation problem to maximize the retailer's profit. Space elasticity on demand and location effect are included in their model. They developed a Genetic Algorithm to solve the problem (Hwang et al., 2009).

In this study, a model is proposed as an aggregated optimization model for shelf space allocation. A modified integer programming model was developed to increase the applicability in practice. The objective is to determine the best allocation of the product items to the most suitable shelf space in order to maximize objective function adding space elasticity factor. A Simulated Annealing (SA) algorithm is proposed to allocate items to shelf space, subject to given constraints.

2. Literature Survey

Carvalho studied the formulation of arc flow including side constraints for one dimensional bin packing problems. A branch and price procedure that unifies overdue variable generation and branch and bound are used for the proposed model. OR Library test data sets were used for this study. A strong lower bound was derived and the linear relaxation leads to tractable branch and bound trees for these instances (Carvalho, 1999).

Lodi et al. (1999) explored the problem class arising from all combinations of requirements that the items were obtained through the sequence of edge-to-edge cuts parallel to the bin edges. A heuristic algorithm and a combined tabu search approach were adapted to change the neighborhood for a specific problem (Lodi et al., 1999).

Fekete and Schepers (2001) studied dual feasible solutions and proposed a simple generic approach to obtain fast lower bounds of bin packing problems. This study also provides a general framework for establishing new bounds (Fekete and Schepers, 2001).

Retailers benefit from the optimum allocation of products into shelves in two ways: they reduce the costs of shelf replacement and inventory, and increase sales. The sales quantity of products depends on many factors such as location of the product within shelf, product facings and adjacent products (Dreze et al., 1994). Anderson and Amato (1973) showed that the companies increased the demand for a product by increasing the display area on the shelf.

Table 1 summarizes the research, algorithms, and references in this area.

Yang presented a greedy algorithm to generate good solutions (Yang, 2001). Lim et al. improved Yang's

heuristic approach and compared the original and the improved heuristics with three metaheuristic algorithms. Their algorithm that incorporates local search found the best results (Lim et al., 2004).

Table 1. Research/Algorithms and references

Research/Algorithm	Reference
Demand model for a product depends on direct elasticity	Corstjens and Doyle (1981)
Dynamic programming solution to a simplified version	Zufryden (1986)
Greedy algorithm	Yang (2001)
Squeaky Wheel Optimization algorithm	Lim et al. (2004)
Integrated mathematical model on multi-level shelves	Hwang et al. (2005)
Data mining approach and association rule mining	Chen and Lin (2007)
A model for two local chains using proprietary data in supermarket	Fadıloğlu et al. (2007)
The wholesalers effect pricing on retailers allocation decisions	Martinez-de-Albeniz and Roels (2011)
Model with elasticities at different aggregation levels	Eisend (2014)

3. Problem Definition

P_{ik} is the profit of the product i on shelf k, X_{ilk} is the decision variable to identify if product i is in the lth position on shelf k, E_{ij} is the cross price elasticity if the product i is to the right of the product j on the shelf, then the objective function can be formulated as:

$$Max\ P = \sum_{k=1}^{K}\sum_{i=1}^{I} P_{ik} * X_{i1k} + \sum_{k=1}^{K}\sum_{i=1}^{I}\sum_{l=2}^{L}\sum_{j=1}^{I} (P_{ik} * X_{i1k}) * (E_{ij} * X_{j(l-1)k}) \tag{1}$$

Subject to:

$$\sum_{i=1}^{I}\sum_{l=1}^{L} a_i * X_{i1k} \leq T_k \qquad k = 1,2,\dots,K\ (shelf\ space\ constraint) \tag{2}$$

$$\sum_{l=1}^{L}\sum_{k=1}^{K} X_{ilk} \geq L_i \qquad i = 1,2,\dots,I\ (lower\ bound\ for\ each\ product) \tag{3}$$

$$\sum_{l=1}^{L}\sum_{k=1}^{K} X_{ilk} \leq U_i \qquad i = 1,2,\dots,I\ (upper\ bound\ for\ each\ product) \tag{4}$$

$$X_{ilk} = \begin{cases} 1 & \text{if the product } i \text{ is located to the } l^{th} \text{ position in the } k^{th} \text{ shelf} \\ 0 & \text{otherwise} \end{cases}$$

Where:
$k = 1,2,\dots,K$ *the number of shelves*
$i, j = 1,2,\dots,I$ *the number of products*
$l = 1,2,\dots,L$ *the position of products*
T_k : *the length of shelf k*
a_i : *the length of product i*
L_i : *the lower bound to allocate product i*
U_i : *the upper bound to allocate product i*

40

4. Simulated Annealing

SA is one of the first available meta-heuristics. Therefore it is not astonishing that it is also the first one to be applied to Quadratic Assignment Problem (QAP) (Ji et al., 2006). SA is a local search that relies on the process of statistical mechanics. Kirkpatrick et al. (1983) were the first researchers who used the Metropolis algorithm as a heuristic to solve the traveling salesman problem. They proposed an iterative local search method called SA to solve combinatorial optimization problems (Kirkpatrick et al., 1983).

Kirkpatrick et al. (1983) proposed a solution procedure to deal with these problems. Annealing is used to obtain a "well ordered" solid state of minimal energy as an experimental technique. This technique includes heating material with a high temperature then lowering the temperature slowly. The SA method includes two parameters; annealing and temperature coefficients (Kirkpatrick et al., 1983) (Dreo et al., 2006).

Figure 1 shows the flow chart of the SA algorithm. When this algorithm is adapted to the placement problem of components, simulated annealing operates a disorder-order transformation (Dreo et al., 2006). The pseudocode of SA is given in Figure 2.

SA starts with an initial solution s (obtained either randomly or from a simple construction heuristic) and generates a new solution s' in each step. Acceptance or rejection of this solution s' is done according to the acceptance criteria. In order to implement an SA algorithm, effective parameters and functions must be specified. For an SA algorithm, an annealing schedule is very important. In this schedule, T0 is an initial temperature, new temperature is obtained from the previous temperature (UpdateTemp), a number of iterations must be performed at each temperature (inner loop criterion), and a termination condition (outer loop criterion) is used (Stützle, 1998).

Since the convergence of the algorithm to an optimum solution under certain conditions can be proved, SA can attract mathematicians on solving the NP-hard problems. Mathematically, the theory of Markov chains can be used to model SA. The SA algorithm converges asymptotically to the optimal solution (Stützle, 1998).

Burkard and Rendl's (1984) motivated simulation procedure for combinatorial optimization problems is one of the first applications of SA to the QAP. It

was demonstrated that SA outperformed most of the existing heuristics for the QAP at that time. The corresponding algorithm yields a promising improvement of the trade-off between computation time and solution quality (Burkard and Çela, 1995). Thonemann and Bölte (1994) proposed an improved SA algorithm for the QAP. A metaheuristic closely related to SA is also applied to QAP by Nissen and Paul (1995) (Erol, 2010).
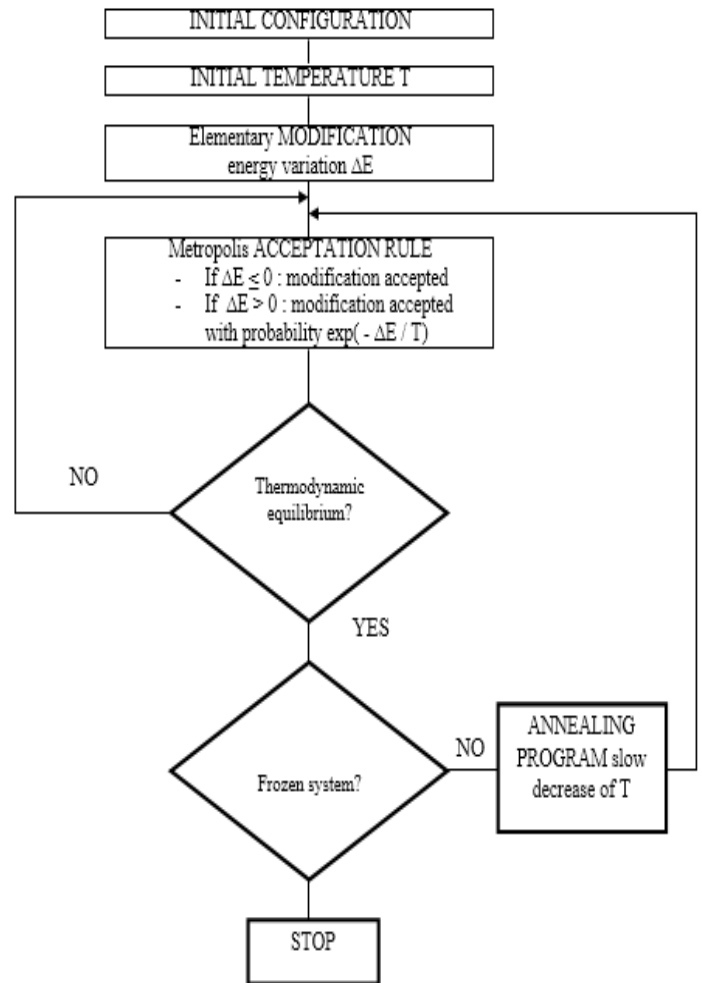

Fig 1. Simulated Annealing algorithm flow chart (Dreo et al., 2006)

procedure *Simulated Annealing*

generate initial solution k, $k_{best} = k$, initial value for T_0, i=0,

while outer-loop criterion not satisfied **do**

  while inner-loop criterion not satisfied **do**

    $k' =$ Generate_Random_Solution (k)

    $k =$ Acc_Solution (T_i ; k ; k')

    if (f(k) < f(k_{best})

      $k_{best} = k$

  end

  $T_{i+1} =$ Update_Temp (T_i), i = i+1

end

return k_{best}

end *Simulated Annealing*

Fig 2. Simulated Annealing algorithm outline. (Stützle, 1998)

Burkard and Rendl (1984) developed a general local search heuristic based on a simulated cooling process applicable to any combinatorial optimization problems once a neighborhood structure was introduced in the set of feasible solutions (Burkard and Rendl, 1984). In particular, Burkard et al. apply SA to the QAP (Burkard et al., 1998). Other approaches for applying SA to QAP are the studies of

Bos (1993), Yip and Pao (1994), Burkard and Çela (1995), Peng et al. (1996), Tian et al. (1996 and1999), Mavridou and Pardalos (1997), Chiang and Chiang (1998), Misevicius (2000 and 2003), Tsuchiya et al. (2001), Siu and Chang (2002). These studies differ from each other on the implementation of cooling process or the thermal equilibrium (Erol, 2010).

The advantages of the SA method are the flexibility on the evaluations of the problem and the ease of implementation. On the other hand, the main disadvantage of SA is the difficulty of adjustments of temperature decrease. SA obtained excellent results for large size problems (Dreo et al., 2006).

5. Simulated Annealing Application

The definitions of the initial temperature and the freezing temperature or the convergence condition are very essential in increasing the speed and accuracy of the SA algorithm. For this reason, many tests are performed to find effective temperatures. The repetition reduction rate is chosen by trial and error. For producing new generation, the switching operator is used in the inner loop thus, this operator can find the best possible result. Process optimization is performed in a Java program.

6. Results and Conclusion

The result of the Simulating Annealing algorithm is summarized in Table 2. In order to evaluate the efficiency of SA, average result of 100 independent runs are given.

Table 2. Comparison of algorithm results

Problem name	Min z	Mean z	Max z	Average run time
Simulated Annealing Algorithm	106.85	162.38	193.85	200.18
Genetic Algorithm (Bilsel et al., 2013)	145.95	162.38	176.25	253.13
Greedy Algorithm (Yang, 2001)	135.90	135.90	135.90	--
Greedy Algorithm with improvements (Ayhan et al., 2007)	146.10	146.10	146.10	--

As can be seen in Table 2, the proposed SA algorithm performs better than the heuristics of both Yang (2001) and Ayhan et al. (2007) its average performance is the same as the genetic algorithm of Bilsel et al. However, for the best (max) solution, the proposed SA algorithm outperforms Bilsel et al.'s genetic algorithm. These results show that SA is more suitable to solve SSAP.

As a future study, more problem instances will be solved to demonstrate the success of proposed SA heuristic.

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