

Full Length Research Paper

Decoding the Civil Engineering Profession: A Systematic Job Analysis and Competency Profile

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Accepted 13 December, 2025

Job analysis contains reports that detail the system, environmental conditions and performance of each job for obtaining higher efficiency. In order to do job analysis properly, information regarding the job have to be evaluated accurately and realistically. The originating point of the current research is based on this requirement. Related researches have mainly focused on either traditional or strategic approaches. Current study, however, has blended these two approaches together with systems approach in order to model a job analysis system and develop related documents. The developed job analysis form has been used to collect data from fifty civil engineers. Collected data has been statistically analyzed in order to be used for job analysis of civil engineers.

Key words: Productivity, job profile, job requirements, time research, project management.

INTRODUCTION

Job is an activity carried out by an individual or team using their physical and mental powers to produce or to reach a result. Job analysis is the studies where the system of job performance, their details and environmental condition are determined and analyzed (Singh, 2008; Sanchez and Levine, 2009). Job analysis has traditionally been used in personnel psychology to determine which knowledge, skills, abilities and other characteristics (KSAOs) are important for successful job performance (Cucina et al., 2005). The history of job analysis is based upon Socrates in the fifth century B.C. and his definition of an ideal state. During those years, Socrates focused on the job that should be performed and whom to perform it, and this represented a conceptual inception for the job analysis. However, the first known record on job analysis originates from Diderot, an encyclopedia scholar. While working on an encyclopedia in 1747, Didero discovered that the jobs involved in occupations, art and craft appeared to be missing and lacking an aim. He consequently explored the quality and content of these jobs, designed them into specific job categories and reorganized the jobs (Singh,

2008).

Furthermore, the "job analysis" concept did not appear in the management literature until the beginning of the twenty first century. In 1916, Frederick Taylor mentioned job analysis as one of the four principles of scientific management. The procedure for job analysis suggested by Taylor was based upon the goals of selecting and motivating the worker and efficiently training him/her. Seeking solutions against various uncertainties encountered by enterprises during the industrialization period; Taylor started to do research on job and methodology, he scientifically went into the piece rate system, job assessment, techniques for selection and placement, close and exhaustive supervision of works, all aimed at increasing job efficiency, where job analysis formed the initial stage and basis of these studies (Uyargil, 1992; Gungen, 1995; Gungor, 2006; Singh, 2008).

In 1922, this field caught so much interest that, Uhrbrock conducted studies on job analysis. Studies by Frank and Lilian Gilbreth on industrial engineering in the early 20th century added to the interest in job analysis (Singh, 2008). Between 1950 and 1960, when the neo-classical management approach came to the forefront, various studies on job analysis based on job enhancement, job expansion and job rotation were conducted, and the human factor was investigated (Gungor, 2006).

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Technological developments in and after 1970 started to render personnel management more complicated, leading to the debut of customized personnel policies suiting the organizational structure of enterprises. By taking into account the mental characteristics of workers, as well as the physical aspects of the job, and developing methods to boost efficiency, the researchers studied the job factor from this standpoint.

In particular, the studies on redesigning the job highlighted the significance of job factor in the organizational life. For this reason, 1980's served as a period when the need to handle job analysis within a broader perspective was felt and studies were conducted in that respect (Uyargil, 1992). Holland (1973, 1985) identified six types of occupations (that is, Realistic, Investigative, Artistic, Social, Enterprising and Conventional (RIASEC)) (Maurer and Tarulli, 1997). Maurer and Tarulli (1997) were to investigate whether the observed profile of relations between variables of traditional job analysis surveys and Holland dimensions was consistent with predictions based on Holland's theory. Thus, Maurer and Tarulli (1997) provide a detailed picture of the work, content, skills and context variables within managerial work that are likely to be associated with the RIASEC dimensions.

In spite of the need to bring a strategic approach to job analysis, only a couple of theoretical initiatives were taken to suggest the framework of strategic job analysis. In the literature, the job analysis discipline is classified into two categories, namely the traditional job analysis and strategic job analysis (Singh, 2008; Schneider and Konz, 1989). Traditional job analysis is an approach where the workers, jobs and harmony between them have definite delimitations and where focus is on the individual job rather than the team-based effort. On the other hand, strategic job analysis is a set of efforts aimed at identifying the tasks that would drive final achievement and knowledge and skills necessary for these tasks (Singh, 2008). In the studies launched, it was found that, though the traditional concept of job survey and analysis became outdated, the job analysis forms required the identification of the tasks to be performed as well as the knowledge, skills and abilities necessary for these tasks (Singh, 2008). Schneider and Konz (1989) reviewed the tasks to be satisfied for the job performance together with the knowledge, skills and abilities necessary for the job within the context of approaches for the traditional job analysis, and developed the "multi-method job analysis". The approach introduced by Stewart and Carson (1997) adopts the dynamic nature of the job, however assumes that, the jobs may be analyzed independently from the workers (Singh, 2008). Snow and Snell (1993) suggest a personnel placement model through a strong human resource planning and management function (Singh, 2008). The authors have argued that, instead of person-nel placement to give rise to some certain fundamental competitions, an in-depth skill background should be developed and enhanced for strategic competence to

yield value. This in-depth skill background helps companies in getting prepared for an unforeseeable and uncertain future (Singh, 2008).

In a study directly related to job analysis, Sanchez and Levine (1994) suggested that, though the outdated traditional concept of job analysis, the job analysis forms could make significant contributions to the competitiveness of the business life, in other words, the variations performed and reported in current job analysis practices required the knowledge underlying the outdated assumptions of job analysis (identifying job responsibilities, tasks to be performed for job performance, and knowledge, skill and abilities necessary for the task etc). In parallel to the suggestions within this broader spectrum, to cope with future uncertainties, the use of strategic job analysis is essential.

On this matter, in a study by Demirtakan in 1996 at the Eskisehir Regional Directorate of Meteorology, he conducted job analysis for 10 ten jobs across total of 32 workers by means of the questionnaire and observation method with a view to bring into light the obvious aspects of the jobs, while identifying the tasks and responsibilities (job definitions and job requirements) for each job and determining the qualifications that a worker should carry (Gungor, 2006). Singh (2008) suggested, it became clear today that job analysis is a cost-oriented sound job practice, capable of improving the communication, hosting the change and contributing to the improved management of human resources. Referring to the past researches, the author argued that job analysis is a knowledge-based system for a wide spectrum of varied organizational and administrative functions, such as worker selection and placement, training and development, recognition of performance, job definitions and harmony between job design and recruitment. With the questionnaire method applied to 34 manufacturing companies operating in Istanbul, Eskisehir and Konya regions, Alp (2003) researched whether enterprises conduct job analysis procedure, and if so, who conduct these procedures and at what frequency. This research revealed that big and medium-scale enterprises involved in the questionnaire conduct job analysis procedures, yet small-scale enterprises fail to do so (Gungor, 2006).

In a study by Hacıoglu et al. (2002) to shed light on the application of job analysis in public organizations, they identified the authorities and responsibilities for functions performed in all administrative units within the Balıkesir University, and determined job definitions and job requirements (Gungor, 2006). In the analysis, the data were processed within a set of combined methods including questionnaire, negotiation, observation, study of past job definitions, discussion and examination of job tools. The questionnaires formed were applied to 153 workers and completed by analysts through face-to-face talks with the workers. Through the information gathered, the duties and responsibilities of units were documented. Next, job definitions and job requirements that constitute

the basic outputs of job analysis were organized by analysts separately for each job. The efforts launched were compiled in a handbook and forwarded to the units concerned, and it was strongly stressed to consistently update these handbooks (Gungor, 2006).

In a more recent article, Siddique (2004) introduces a detailed insight into the constructive impact yielded by a competition-based job analysis approach. The author argued that, the proactive job analysis could contribute to organizational performance by highlighting prominent characteristics such as teamwork, various skills, innovative way of thinking, flexibility, decision-making ability and self-motivation, and encouraging positive job attitudes (Singh, 2008). Gungor (2006) developed job definitions and job requirements form in order to conduct a job analysis on the Kesan Municipality and all other municipal organizations. The research was applied to the personnel comprised of workers and servants within the permanent staff at the Kesan Municipality. Separate job definitions were created for the personnel and job requirements were addressed. In the study, the jobs performed in the municipality were analyzed, their obvious characteristics, sub factors, duties and responsibilities across these jobs were identified, individual features that the personnel should carry for a given job, ideal working environments and achievement standards were examined, and ultimately the awareness of the worker in his/her job was raised. McEntyre et al. (2006) suggested the metric approach that is a qualitative and quantitative method for organizing and processing the job analysis data. The authors highlighted the significance of computer software and utilities such as O*NET or metric system to gather job analysis data due to rapid job circulations leading to inadequate pace of job analysis, the analysis's insufficient role in making complex decisions and immobility of job analysis data. The metrics in the article have been discussed at a level that would organize and analyze the basic job analysis data under cooperation with the Department of Defence and the University of Oklahoma, and help in decision-making and training.

Sanchez and Levine (1994) argued that traditional measures of job analysis accuracy (interrater agreement and comparison with a standard) were of limited value and they suggested to evaluate job analysis methods against criteria based on how these methods were used or on their 'consequential validity'. Supporting the aforementioned researchers, Morgeson and Campion (2000) agreed with Sanchez and Levine and offered a model of the inference process required for conducting job analysis. Harvey and Wilson (2000), on the other hand, argued strongly that if job analyses were properly conducted and focused on concrete, specific behaviors, it was possible to demonstrate meaningful accuracy (Spector, 2000).

"Personality-Related Position Requirements Form (PPRF)" was described as a supplement to other job

analysis techniques for making personality predictors. Big Five Personality Factors and 12 sub dimensions were additionally suggested for providing an organizing framework for PPRF (Raymark and Schmit, 1997). Landis et al. (1998) addressed that a specific approach-future oriented job analysis (FOJA)- for understanding newly formed entry-level positions in a large insurance organizations as traditional methods for conducting a job analysis were not likely to be completely transportable to these situations. Sanchez and Levine (2009) argued that, Competency Modeling (CM) had the potential to fill an important void in Traditional Job Analysis (TJA), specifically the infusion of strategic concerns in day-to-day employee behavior. Writers have compared TJA and CM along six dimensions: purpose (describe versus influence behavior), view of the job (an object to be described versus a role to be enacted), focus (job versus organization), time orientation (past versus future), performance level (typical versus maximum), and measurement approach (latent trait versus clinical judgment). It was recommended to join TJA with CM, so that an organization might achieve, among other outcomes, the critical purpose of directing employee behavior toward the accomplishment of its strategic objectives. While TJA focused on describing and measuring the requirements of work, CM created a conduit to influence day-to-day employee performance along strategic lines.

Wei and Salvendy (2003) utilized the Purdue Cognitive Job and Task Analysis (CTA) methodology, the Human Centered Cognitive Performance model based Purdue Cognitive Task Analysis Questionnaire, which not only analyzed jobs and tasks, but also provided a mechanism for improving cognitive job and task performance. Specifically, the utilization of this methodology could assist job evaluation, job design and job rotation and personnel selection and training. The research undertaken by the aforementioned authors followed a long line of job and task analysis research and the development of human job and task ability requirement taxonomies such as the PAQ and the F-JAQ. It aimed at capturing the complete cognitive capability requirements for job design (Wei and Salvendy, 2003). The authors stated that the utilization of this methodology might help to assist job evaluation, job design and job rotation, and personnel selection and training. It also might help to investigate pitfalls in existing job designs. They suggested new job design based on sensitivity analysis of developed cognitive graphs, to provide efficient training for high cognitive ability requirement tasks, and to provide suggestions on safety and health criteria to job analyzers, job designers and company decision makers. Therefore, this method might contribute significantly in improving human performance in the cognitive domain in industrial job (re)design.

In the studies made, though the traditional concept of job research and analysis is outdated, it is mentioned that in the job analysis forms, the knowledge, skills and

capabilities necessary for the mission are required to be specified (Singh, 2008; Sanchez and Levine, 2009). During this study, taking these two approaches as a base, efforts have been spent to obtain the information and data to be used by companies for success of various functions of human resources. In literature, following information has been reached concerning the purpose and fields of use of job analysis (Akal, 1981; Uyargil, 1992; Donna et al., 1995; Sanchez et al., 1998; Palmer and Valet, 2001; Siddique, 2004; Gungor, 2006; McEntyre et al., 2006; Singh, 2008; Sanchez and Levine, 2009):

1. To obtain the data related with the job and the job requirements;
2. To make the job spare and clean and to determine the performance measure methods;
3. To arrange the production standards available for increasing the productivity and efficiency of the performer;
4. To establish a balanced remuneration system by making job evaluation and performance assessment;
5. To determine the number of employees to be needed in the future and to assist the human resources planning developing net and clear criteria in hiring them;
6. To realize power and liability distribution at the corporations;
7. To determine the training requirement or that may occur currently or in the future;
8. To provide the carrier plan to be made properly and soundly;
9. To be a basis for records and statistics that shall maintain the necessary data regarding legal regulations of the job and the performer;
10. To improve the working conditions;
11. To provide job security measures be taken and the audition to be made properly;
12. To contribute in arrangement of the trade union activities.

Success of job analysis requires the analysis to be made through advanced methods such as sophisticated qualitative and quantitative computer software of information and data obtained from job analysis forms and through various statistical techniques (McEntyre et al., 2006). The job analysis model established in accordance with system approach is also to be benefited when developing job analysis forms from which this information and data are obtained.

JOB ANALYSIS MODEL RECOMMENDED FOR CONSTRUCTION SECTOR

Construction companies are now in an effort to reduce the costs and to obtain higher productivity in order to be able to compete under the economic crises suffered. This can only be possible, if these companies determine how each job is performed, its details and environmental

conditions and therefore through sound and proper job analysis. The structure of job analysis model developed during the current research is the product of results obtained from previous researches (Schneider and Konz, 1989; Raymark and Schmit, 1997; Maurer and Tarulli, 1997; Landis et al., 1998; Wei and Salvendy, 2003; Gungor, 2006; McEntyre et al., 2006; Singh, 2008; Sanchez and Levine, 2009).

In this respect, taking into consideration the purpose and principles of job analysis in the study, a job analysis method has been developed, available to be used in the construction sector and other sectors. Related researches have mainly focused on either traditional or strategic approaches. Current studies however, have blended these two approaches together with systems approach, in order to model a job analysis system and develop related documents. Scientific system approach has provided integral and inter-disciplinary approach to be handled together (Yegul, 2010). During the study, job analysis model is discussed in three phases as the preliminary preparations stage, analysis stage and conclusion stage (Figure 1).

Preliminary preparation studies of job analysis

Preliminary preparation studies for construction firms start with clearly defining the perception of obligations and aims of the organization and the strategic role of each unit within the organization. Before starting the analysis of a job, preliminary information has to be obtained about that job by benefiting from the organizational structure of that firm regarding that job, catalogues related with the job, definitions, job studies and job flow diagrams. Respectfully, jobs in all departments of the business place and working conditions where the job is performed (number of employees, remuneration etc.) are to be analyzed and notes and information obtained are to be classified and arranged according to jobs. Especially when similar jobs, jobs with similar contents but different titles are required to be analyzed, then these are to be named with the same title. When job analysis is made, the subjects to be analyzed are to be recorded on a job analysis form (Gungor, 2006; Anonymous, 2010).

The second phase of preliminary preparation stage consists of selection of the analysts to conduct the job analysis. Analysts have to be capable of collecting the data regarding the facts and jobs, and of evaluating and compiling them. In this context, analysts may be selected from inside or outside the corporation or from consultant firms specialized in this type of analysis. The third phase of preliminary preparation stage consists of determining the techniques and the data collection methods to be used in job analysis. In literature about the job analysis techniques; methods are specified such as functional job analysis, critical event technique, case analysis inquiry, time research, method research and micro action

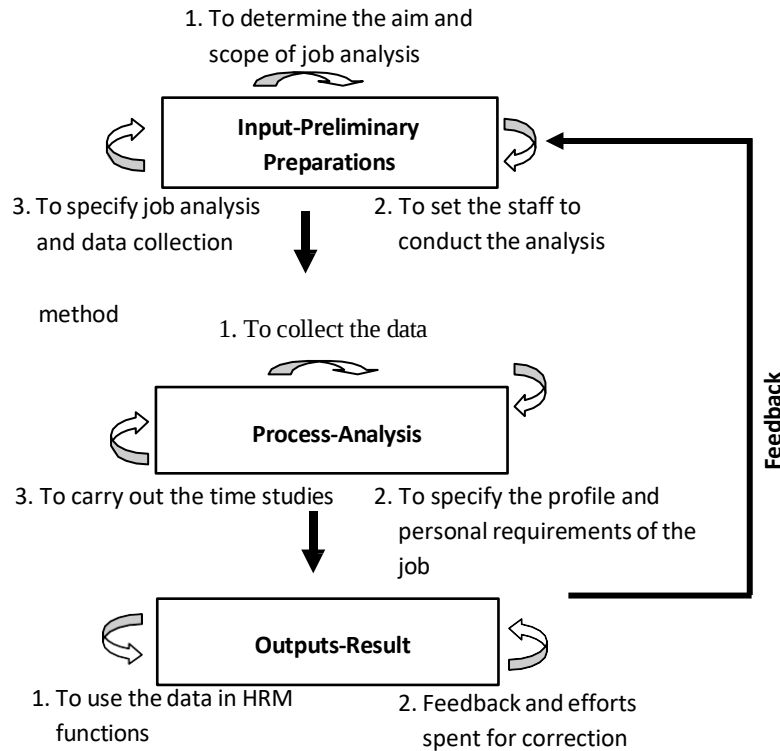


Figure 1. Systematic approach to job study and analysis discipline.

research. Regarding the data collection methods used during analysis; literature is involved with review of previous job definitions, daily performance of job, benefiting from diary of performer, interviews with employees or superiors, observations and classification as inquiry method or combined job analysis (Sanchez et al., 1998; Ozgen et al., 2002; Celikten, 2005; Gungor, 2006).

Analysis stage

At this stage, profile and the personal requirements about the job obtained through the job analysis form and information and data obtained with time research studies are analyzed. In this phase, primarily the data necessary for job analysis are to be collected. The assessments after obtaining the data should be made with sophisticated qualitative and quantitative computer software, various statistical techniques, and comments and observations (McEntyre et al., 2006).

Conclusion stage

At the conclusion stage of job analysis process; the information obtained, job/duty definitions, requirements related with job etc. are converted into job standards and used by human resources department in decisions regarding the employees and in efforts spent for correction. With job analysis, development plans of the

company for future and the preventive aspects of the organization are put into force. Faults made in the past are to be analyzed realistically and new standards are developed aimed at future or the already available standards are arranged and improved. Therefore, it is necessary for corporations to continue their studies regarding job analysis.

APPLICATION-JOB ANALYSIS FORM

During the study, in accordance with the purpose and scope of job analysis, a job analysis form has been developed taking into consideration the job analysis method and data collection techniques (Loosemore, 1996; Raymark and Schmit, 1997; Ocal, 1999; Wei and Salvendy, 2003; Anonymous, 2004; Erdis, 2004; Dawson and Price, 2005; Oral et al., 2007). Parts of the form shown in Figure 2.

Job analysis form consists of two basic activity groups as method research and time research. The method research part of the study is aimed to specify the personal eligibilities and job profiles of the civil engineers employed in the sector. In this part, questions have been asked to civil engineers, in order to determine the profile of the job they perform; regarding job/duty definitions at the firms they work, capabilities/requirements necessary to perform the job, job and performance assessments, remuneration, carrier and training planning, labor health and safety, quality control and the socio-psychological

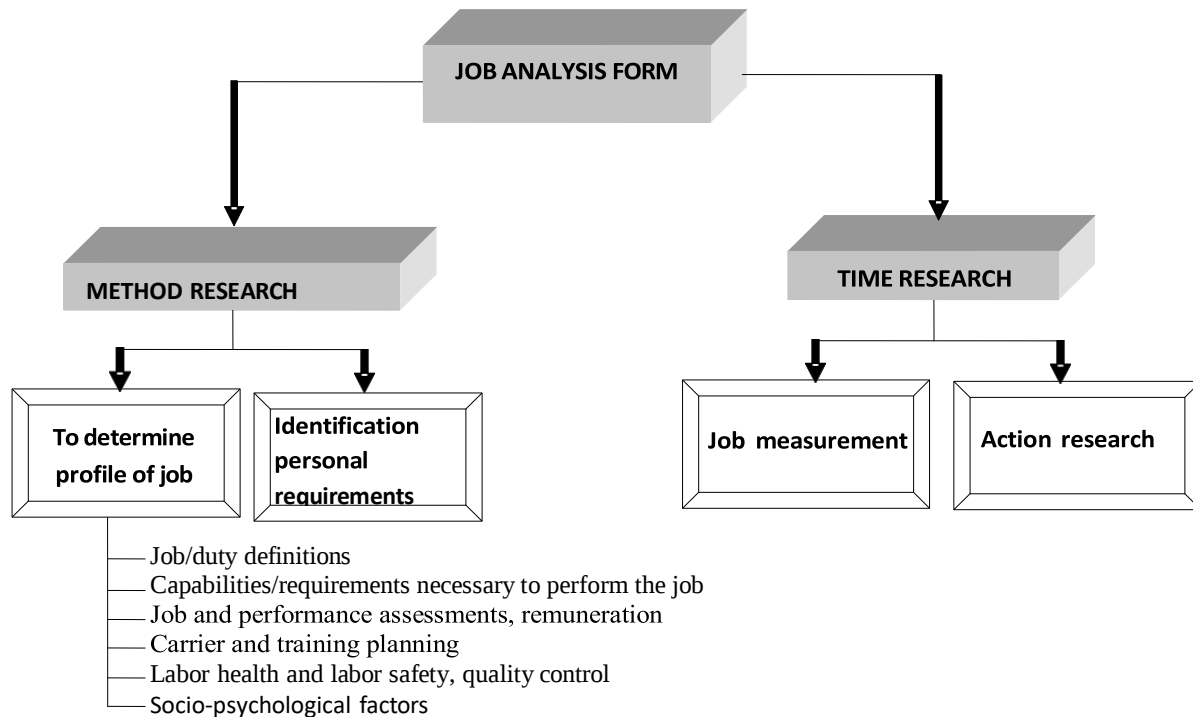


Figure 2. Activities of job analysis form.

factors concerning the job.

In the time research part of the form, questions are included regarding the arrangement of job flows and improvement/redesign of working conditions in accordance with the characteristics of the person, using the principles of job measuring and action economy. In the job measurement part, information is sought, regarding especially how the production stage at construction companies is programmed and how it should be programmed.

MATERIALS AND METHODS

The form developed in this study has been completed by interviewing 50 (fifty) civil engineers at manager positions, employed by large- and medium-sized construction firms. During completion of the form, there was no adequate time for interviews and observations due to the fact that the operation field of construction companies is extensive and there is heavy work. Detailed preparation of job analysis form and explanations made during completion of the form have also extended the completion time of the form, as well as the process to obtain the data necessary for representing the main mass of specimen. These delays are tried to be avoided by establishing good personal relationships with those answering the form and through face-to-face interviews. In compiling the answers to the job analysis form, frequency tables are used for analyzing the distribution and variation of the data measured. Answers to questions regarding their rate of significance are analyzed using "Likert Scale" for grading questions, and "Thurstone Comparative Double Judgments" method for selective questions (Yukselen, 2000). Results of hypothesis tests are also discussed in the paper.

RESEARCH FINDINGS AND EVALUATION

The findings part of the study has been constituted from evaluation of form results and from observations. Also in this part, points of view of the construction companies towards job analysis are evaluated. The position and educational status of respondents were satisfactory in terms of presenting the general approach of the companies realistically. This part consists of the „method research" stage where personal requirements and job profile are specified and the „time research" stage where the information is included for determining the work flows and working conditions to increase production factors.

Method research

The part of method research consists of analysis of answers given, regarding personal requirements and job profile, concerning job performance culture of civil engineers. The questions were answered by 50 (fifty) managers who are civil engineers authorized by the companies. The results obtained from these answers are summarized in the following.

Personal requirements

The civil engineers who completed the form regarding personal capabilities, pointed out that, in order to consider himself as a specialized engineer, she/he has to

Table 1. The level of importance paid by civil engineers in evaluation stage of duties and responsibilities.

Stage of duties and responsibilities	Average rate (X_{ao})	Standard deviation (σ)	Coefficient of variation (V)
During construction	2.14	1.56	0.73
Preliminary preparation phase	1.96	1.46	0.75
Completion phase	1.86	1.33	0.72
Quotation phase	1.70	1.55	0.91

work in the sector for a minimum of 7 to 8 years in the sector to gain experience. In other words, civil engineers emphasized that the range of 31 to 40 years of age (54%) is the turning point for a civil engineer to reach the personal perfection.

Determination of the profile for the job

In this part of the job analysis, only the selected results that are considered to be the most important are included. The results related to study job descriptions for civil engineers, business requirements and socio-psychological factors affecting job are given.

To define the job/duty: Regarding the answers given by civil engineers concerning the job/duty definitions, it is observed that civil engineers work 51 to 60 h per week (38% answer users), and they stay for a period of one month (66%) outside the region as required by their job/duty and outside the city, as required by other activities concerning the job. Civil engineers, concerning the project-study group meetings which require participation due to their job, stated that, they join the job progress meetings weekly in general (51%) and to project coordination meetings daily or monthly (14%). These points indicate that the leisure time of the civil engineers is insufficient. The answers given by civil engineers regarding the level of importance they pay for their duties and responsibilities indicate that, they give higher significance to the construction phase of the job ($X_{ao}= 2.14$) as shown in Table 1. During face-to-face interviews, they stated that the reason for this is that they feel like civil-engineer when the work appears at the production stage, and feel proud of their profession and be satisfied with the work they have done. This is also the factor upon which those who answer the job analysis form agree the most ($\sigma =1.56$; $V =0.73$). Civil engineers also stated that, during the preliminary preparation phase, activities such as project preparation and pre-estimation have been another important power for them, both regarding duties and responsibilities, and regarding job satisfaction ($X_{ao}=1.96$, $\sigma=1.46$; $V=0.75$). When taking apart in completion phase ($X_{ao}=1.86$, $\sigma=1.33$; $V=0.72$) and quotation phase ($X_{ao}=1.70$, $\sigma=1.55$; $V=0.91$), duties and responsibilities are important for them but they do not care for them as much as they do for the duties and responsibilities included in the two phases stated earlier.

Civil engineers, though mostly not included within the scope of their duties, stated that they get involved in other works such as administrative tasks, in addition to the construction works of the company. In fact, this is mentioned to be the most important case which affects adversely the job carried out by civil engineers by respondents. Concerning the question related with works which are not performed by civil engineers, although included within the scope of their job in the company; the respondents indicated that they do not want to get involved with the modifications to be made on the project and with the detailed drawings, and many of these modifications are required to be done by the project manager. Within the scope of jobs which the civil engineers do not perform in the company but state to be useful, they pointed out the importance of organizational system of management and the clear definition of jobs. They emphasized the requirement of revision/ restructuring of management functions of Turkish Construction Companies on these subjects. Regarding this subject, Snow and Snell (1993) have pointed out the importance of a properly structured model of personnel placement with a strong human resources planning and management function (Singh, 2008). London (1998) stated that, organizations and managers have to think on what should be done about vitally important jobs of the future and to ensure the availability of the right people with right skills at the right time (Singh, 2008). Singh (2008) stated that, strategic job analysis could be determined with general and broad characteristics of skilled personnel. The hypothesis test showed that, there is a relationship between the duration of experience and the degree of importance given to management functions during work (Planning, Organization, Coordination, Command-Control and Inspection activities-POCCI). Results of the hypothesis test conducted between the management functions and duration of experience are given in Table 2. The results using SPSS 16 ($\chi^2= 7.447$), showed H_0 to be rejected since for 95% confidence interval $P=0.024<0.05$, as shown in Table 3. In other words, there is a significant relationship between application of management functions of companies and the professional experience. In other words, the two variables are dependent on each other. This point indicates that, the companies have to work with civil engineers bearing satisfactory experience, to fulfill the management functions perfectly. This result indirectly indicates that the number and quality of courses given in project

Table 2. Hypothesis data establishing relations between management functions and professional carrier.

Focusing on management functions	Professional carrier		Total
	< 7 years	>7 years	
Very important	31	0	31
Important	12	3	15
Neither important nor unimportant	4	0	4
Total	47	3	50

Table 3. Results of multi-box chi-square hypothesis test conducted with the SPSS 16 package program.

Chi-square tests	Observed rate	Rate of independence	P (2-directions)
Pearson Chi-square*	7.447	2	0.024
Likelihood ratio	7.685	2	0.021
Linear-by-linear association	2.233	1	0.135

management and construction management should be increased.

Requirements for performing a job/duty: Civil engineers who answered the form, regarding the necessary capabilities to perform a job, pointed out the significance of the 20 to 30 age range (80%), sex as male (100%), minimum license degree as well as bearing a certificate regarding the job (36%), especially concerning computer and professional training (40%), medium level of foreign language (49%), computer knowledge at least at the level to use especially various package programs such as MS Office (61%) and MS Project and Primavera (32%), bearing a driver's license (99%) and registration to the Chamber of Civil Engineers (90%). These points indicate that regarding term, quality, cost and therefore productivity of the job, civil engineers are required to make a progress in any subject.

Socio-psychological factors: The problems faced by civil engineers when performing their jobs are listed as follows:

1. Civil engineers pointed out that the greatest power, effective in performing successfully a job or a duty assigned, is the current work load (Xao= 4.40). This power is also the factor agreed upon the most by those who completed the form ($\sigma = 0.75$; $V = 0.17$).
2. Civil engineers consider that data related with the previous jobs if not held, duties, obligations and responsibilities if not specified clearly, are the other important factors that may impair the effectiveness of the job, as different job performance cultures and deficiencies of trade groups, included in the organizational structure and other departments (Xao = 3.96, Xao =3.96,

Xao=3.90).

3. It is understood that the organization members do not trust but are afraid of each other, that they have the habit of not telling the faults they see, and weak communication and dialogue, failure of systemizing or operating the information network are not considered as important factors in performing a job (Xao=3.54, Xao=3.52, Xao=3.48).

4. Answers given by civil engineers regarding what the socio-psychological problems are; mostly include, regarding the job are analyzed by the Law of Thurstone's Comparative Double Judgments and the results are outlined by "Table of Personal Preferences and Results of Normal Distribution" (Table 4 and Figure 3).

5. Civil engineers listed their preferences respectively, regarding socio-psychological problems suffered during the job as I>III>V>IV>II. Concerning this subject, civil engineers attracted attention first to fatigue and weariness and then to high rate of labor force transfer. Other factors were irregular attendance-unwillingness to work, attitudes that impair the personality of the performer, failure to create the desire for performance.

Time research

Time research is the operations regarding how and which criteria the companies program their work, by benefiting from work measurements and action economy principles, for the purpose of combining the job and human elements in the most proper way.

Job measurement

When programming the production phase regarding the

Table 4. Socio-psychological factors that affect job for personal preferences and results of normal distribution table.

Measures to be taken	Preferences				
	I	II	III	IV	V
I- Fatigue and Weariness	---	5	20	10	13
II- Irregular attendance	45	---	40	31	33
III-High rate of labor force transfer	30	10	---	15	16
IV- Attitudes that impair the personality of the performer	40	19	35	---	27
V- Failure to create the desire for performance to be appreciated or accepted	37	17	34	23	---
Total ZIJ (normal distribution results)	3.020	-3.27	2.025	-1.155	-0.310

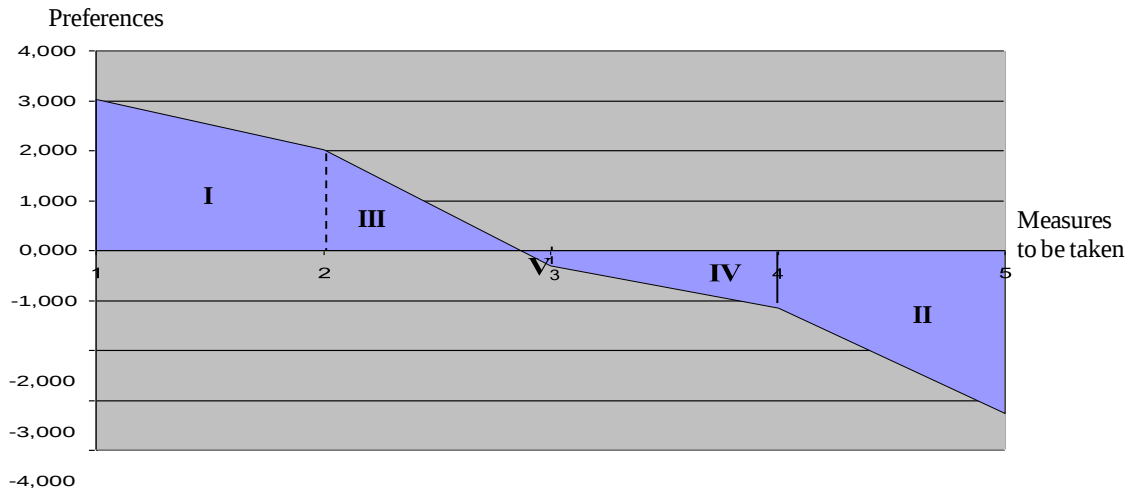


Figure 3. Socio- psychological factors that affect job for personal preferences and results of normal distribution.

job measuring operations of companies and civil engineers, it is observed that they generally use the former jobs and experiences as a basis (53%). To program the production phase, however, 44% of civil engineers use the prepared work programs. It is observed that when the engineers plan the production phase, they generally use the bar programming method (26%) and also the network diagrams (25%) within this scope. Again when programming the production phases, it is observed that Excel is used (55%) in general and the use of package programs is getting significantly and widely spread (MS Project: 34% and Primavera: 10%).

Civil engineers pointed out that, in order not to delay the work schedule in their firms; they generally prefer studies regarding preparation activities that affect production-aimed operations or operations extended due to technical difficulties (25%). Besides that, they carried out studies regarding vertical or horizontal hierarchical realization of jobs (23%), as well as studies concerning severability and portioning of jobs into steps or phases (21%). It is observed that civil engineers, for the sake of timely delivery, arrange the work schedule in accordance with increasing the productivity and work speed of the product phase, as well as increasing the use of different

construction technologies together with the increasing number of employees (55%).

Action research

Concerning the methods increasing the productivity of manufacturing factors, results obtained by Likert scale are summarized as follows:

1. Civil engineers who complete the form, specified that the greatest power that increases the productivity of production factors is the social assurance, and this can only be made through improvements both in job, and in the subject of health and social assurances (Xao= 4.54). This power is also a factor upon which those who completed the form agreed the most ($\sigma=0.54$; $V=0.12$).
2. Civil engineers stated that perfect performance of (management functions), planning, organization, coordination, guiding and inspection operations, is the second important factor that increases the productivity of production factors (Xao=4.54, $\sigma=0.64$; $V=0.14$).
3. Civil engineers emphasized that as the third factor, use of trained labor may also increase the productivity of production factors (Xao=4.54, $\sigma=0.73$; $V=0.16$).

4. It is understood that failure to provide satisfactory service from analysis results and failure to be sensitive to internal and external circumstances are not considered as factors that affect the productivity of production factors (Xao=3.54; Xao=3.46).

Civil engineers furthermore consider delay of materials (21%) and equipment to be used and the temperature of the working environment (21%) also; as factors that affect the productivity of production factors.

CONCLUSION AND RECOMMENDATIONS

Productivity is one of the important determinants of success in the construction industry like other industries. However, unlike production in the manufacturing industry, production in construction is labor driven. Thus, it is very important to employ high productive labor/personnel, for the successful completion of construction projects. This paper thus focuses on determination of critical factors that both affect productivity of construction managers/engineers and increase their productivity. Job analysis together with systems approach was utilized, in order to establish the details, methods and environmental factors that affect the productivity of construction managers/engineers. Job analysis forms which would help personnel department to both analyze the productivity of construction engineers and select high productive engineers was also modeled.

Job analysis forms were used to collect data related with the main outputs of job analysis; that is work/ responsibility descriptions and requirements for construction engineers and socio-physiological factors affecting their productivity. Collected data was then gathered together as a handbook. This handbook is expected to be a basis for personnel selection, personnel payment, training and productivity improvement policies. Future work comprises adaptation of the model into a computer based data management system, which would help to collect, arrange and analyze work analysis data and present the findings in a report form to personnel/company managers. It should always be remembered that while job analysis is a costly process, not undertaking a job analysis may be a more costly process for a company.

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