CHAPTER 2
LITERATURE REVIEW AND THEORITICAL BACKGROUND

2.1 Literature Review

Performance Appraisal can be defined as a system that involves setting employee standards, looking at employees' actual job performance, assessing that performance against the standards, giving feedback to the employee on the performance, how to improve it in the future and setting new goals and expectations for another period (Dessler, 2008). From Dessler words it shows that in doing the performance appraisal there are several parts that related one with another, it is appropriate with the words of Lambert (2009) which says performance appraisal is a completely integrated system involving periodic planned discussions between the manager and employee's total performance against predetermined goals, having the manager to coach and counsel the staff in areas requiring correctives actions, to improve overall performance for the benefit of both employees and the total organization. From Dessler and Lambert statement, it is indicated that in performance appraisal activity there are an integrated of several steps that have the same goal which is to assess the performance of the worker and also it can be assess the top management in order to achieve the certain goal that has been set by the organization.

Venclova Katerina, Salkova Andrea Kolackova Gabriela on their research stated about the classification of employee performance appraisal methods based on the time factor according to the time factor according to the authors are shown on the table below. The differences of time horizon are divided into three which are past, present, and future. Methods focusing on the past are mentioned as past events, methods focusing on the current situation are the present situation and methods focusing on the future are mentioned as future forecasts (Hronik, 2006). Dvorakova (2012) also divides the methods based on the time criterion and differentiate the methods between the methods that is concentrating on the works which is already done (on the past) and methods concentrating on the future and identifying the development potential of employees.

Table 2.1. Appraisal methods according to the time perspective as categorized by Czech authors. Source: Czech authors data processed based on information obtained from selected publications (Hronik 2006; Duda 2008: Dvorakova 2012)

	Methods focusing on the past	Methods focusing on the present	Methods focusing on the future
	Hronik – X, Dvorakova – Y, Duda – Z		
Critical Incident Method	XYZ		
Assessment/Development Centre		X	YZ
360 degree feedback		X	Y
Management By Objectives	Y		
Predefined Standard Fulfilment based Performance Appraisal	Y		
Checklist	YZ		
Rating Scales	YZ		
Behaviorally Anchored Rating Scale	Y		
Confidential Report	Y		
Paired Comparison	YZ		
Self – Assessment			Z

Table 2.1. shows that most methods such as Critical Incident Method, Management By Objectives, Predefined Standard Fulfillment base Performance Appraisal, Checlist, Rating Scales, Behaviorally Anchored Rating Scale, Confidential Report, and Paired Comparison are used for the past time horizons.

The advantage of methods focusing on the past is the methods deals with the work that is already done and so make it relatively measurable.

Venclova Katerina, Salkova Andrea Kolackova Gabriela mentioned another classification method based on the foreign specialist. The foreign classifications about the methods are divided into four class, they are:

a. Traditional and Modern Methods (Deb, 2006; Khurana, Khurana and Sharma, 2010; Randhawa, 2007)
b. Objective Methods or Performance Oriented Methods and Judgmental Methods (Griffin, 2012; Pride, Hughes and Kapoor, 2012)
c. Scaling Methods, Narrative Methods (Mathis & Jackson 2011)
d. Comparative, Rating, Narrative and Behavioral Methods (Bogardus, 2007, Schermerhorn, 2011)

Table 2.2. Classification of Appraisal Method according to the foreign authors. Source: Czech authors processed based on information obtained from selected publications

	Authors							
	A	B	C	D	E	F	G	H
Traditional Methods	√	√	√					
Ranking Method	√	√	√					
Paired Comparison	√	√	√					
Rating Scales	√	√	√					
Forced Choice Method	√	√	√					
Forced Distribution Method	√	√	√					
Essay Method	√	√	√					
Group Appraisal Method	√							

Cont. Table 2.2. Classification of Appraisal Method according to the foreign authors. Source: Czech authors processed based on information obtained from selected publications

|								
Critical Incident Method	√	√	√					
Field Review	√	√	√					
Confidential Reports	√	√	√					
Checklist		√	√					
Person to Person Comparison			√					
Modern Methods								
Management By Objectives	√	√	√					
Assessment Centre	√	√	√					
Human Resources Accounting	√	√	√					
Behaviorally Anchored Rating Scale	√	√	√					
360 – Degree Feedback	√	√	√					
Psychological Appraisals			√					
Judgmental Methods								
Behaviorally Anchored Rating Scale				√				

Cont. Table 2.2. Classification of Appraisal Method according to the foreign authors. Source: Czech authors processed based on information obtained from selected publications

Rating Scales				√	√				
Ranking				√					
Rating				√					
Scaling Methods									
Checklist						√			
Graphic Rating Scales						√			
Behaviorally Anchored Rating Scale						√			
Narrative Methods									
Free Essay Method						√	√		
Critical Incident Method						√	√		
Confidential Reports							√		
Comparative Methods							√	√	
Paired Comparison							√	√	
Ranking							√		
Forced Distribution Method							√	√	
Forced Choice Method							√		
Rating Methods									

Cont. Table 2.2. Classification of Appraisal Method according to the foreign authors. Source: Czech authors processed based on information obtained from selected publications

Checklist							√	
Rating Scales							√	√
Behaviorally Anchored Rating Scale								√
Behavioural Methods								
Behaviorally Anchored Rating Scale							√	

Explanation about the authors in the table A refers to Deb, 2006; B refers to Khurana et al, 2010; C refers Randhawa, 2007: D refers Griffin, 2012; E refers to Pride et al, 2012; F refers to Mathis & Jackson, 2011; G refers to Bogardus, 2007; H refers to Schermerhorn, 2011.
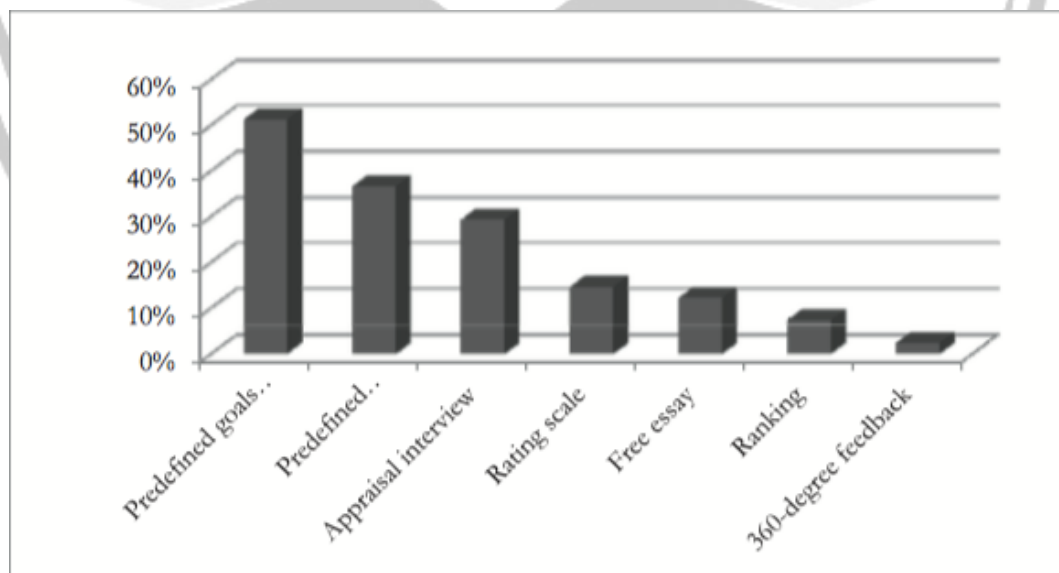
Figure 2.1. Appraisal methods in agricultural organizations in the Czech Republic. Source: Venclova, Konigova, Fejfar (2013)

Figure 2.1. shows the performance appraisal use in the Czech Republic with the agricultural organizations. The most commonly performance appraisal used are predefined goals based performance appraisal (51.2%), predefined standard fulfilment based performance appraisal (36.6%), appraisal interview (29.3%), rating scale (14.6%), free essay (12.2%), ranking (7.3%), and 360-degree feedback (2.4%). Predefined goals and predefined standard fulfilment based is a method where the employee and supervisor make an agreement related to the main goals or standard that is need to be fulfilled for a certain period of time. In reaching the agreement between the employee and supervisor are taken much time, because the supervisor needs to make sure that the goals and the standard that they mention can be understood by the employee.

Grote (2002) identified the following purposes of performance appraisal:

a) Providing feedback to employees about their performance.

b) Facilitating decisions concerning pay increases, promotions, layoffs.

c) Encouraging performance improvement.

d) Setting and measuring goals.

e) Determining individual and organizational training and development needs.

f) Confirming that good hiring decisions are being made.

g) Provide legal support for personnel decisions.

h) Improving overall organizational performance (pp. 4-5).

Providing feedback to employee is important because the worker need to know how the appraiser assess their performance. The transparency in appraising worker will lead to the worker trust to the performance appraisal activity in the company and make the worker want to follow and evaluate themselves according to the performance appraisal result. The result of performance appraisal will affect the top management decision to increase salary, promotions, incentives, layoffs, and specific action that will use to increase performance of the worker by training and development for the worker. By increasing the performance of the worker by using the performance appraisal activity it means increasing overall organizational performance, because the worker performance can increase productivity and it also will increase the profit of the organization.

There are five indicators for measuring the performance of individual employees according to (Robbins, 2006), as follows:

a) Quality, measured by the quality of work produced and the perfection of the work.

b) Quantity, the amount produced in a particular period, such units.

c) Timeliness, completion of work in accordance with the time set by the company.

d) Effectiveness, the level of use of all the resources of the organization are optimized to get the results from each unit of resource use.

e) Independence, an achievement level or where the employee has the responsibility and commitment to the organization.

The purposes for these appraisals include giving feedback to employees that will facilitate improvement in future performance, identifying employee training needs as well as providing the opportunity for organizational analysis and development (Wesley, 1994). It shows that the main goal of performance appraisal is for achieving the goal of the company itself.

Employees are resources in organizations, and as such they need to be trained and developed properly in order to achieve an organization's goals and expectations (Brewster, 2007). Regarding to Pfeffer (1998) employees are important assets that should be invested to develop the skills of the employees itself. Therefore, from the opinions of Brewster and Pfeffer it shows that it is really important to give the employees some training to improve their skills, because the worker is a crucial part in an organization because they since the workers are directly involved in every department and every activities of a company. Since the workers are directly involved in company departments and activities, it makes the worker performance are related to the performance of the company. In the word of Mathis & Jackson (2009) performance is associated with quantity of output, quality of output, timeliness of output, presence/ attendance on the job, efficiency of the work completed (and) effectiveness of work completed. Worker performance is how the input in organization which is human to do their job. According to Thao, and Hwang on their research "Factors Affecting Employee Performance– Evidence from Petrovietnam Engineering Consultancy J.S.C" they stated that there are 5 things that affecting the worker performance which are leadership, coaching, empowerment, participation, organizational culture. Leadership is a process when one person is leading other person or groups in other to achieve a specific goal. Coaching is a process that provided by the company to train the organization according to the certain skill that is needed by the worker. Empowerment is a process when the management give the worker authorities, tools, and powers to do their job. Participation is the involvement of worker in the process that goes on the company. The last one is organization culture, organizational culture is the

mindset of the people not only the worker in the organization but also their activities and habits in their organization that make the organization different with the other organization.

The relation between performance appraisal and worker performance based on Rudman (2003), performance appraisal policy is a critical factor in an organization in enhancing the performance of the employee. If the performance appraisal instrument implemented properly it will affect the worker performance and also will affect the activity of the organization, to achieve their goals. According to Vignaswaran (2005), Gerhart (2004) they define that more specifically, these Human Resource practices increase organizational effectiveness by creating conditions where employees become highly involved in the organization and work hard to accomplish organizational goals. Human Resources practices are expected to influence both, organization's and employee's performance via the workforce's ability (e.g. using selective hiring, training), motivation (e.g. pay for performance by using performance appraisal), and opportunity to contribute (e.g. using teams and suggestion systems). One of the Human Resource practice is performance appraisal, so based on the statement before performance appraisal is part of Human Resources practices that can increase the organizational effectiveness.

Roberts and Reed (1996) found evidence of a positive relationship between satisfaction and acceptance of performance appraisal outcomes with employee perceptions that their supervisors encouraged participation, assisted in goal setting and provided frequent feedback. From Roberts and Reed (1996) it shows that the performance appraisal brings positive feedback and advice from the worker, if the worker satisfy and accept the outcome of performance appraisal they will do their job well.

Huselid (1995) found a correlation between high performance work practices (including close links between appraisal and pay) and organizational performance. This organizational performance including the performance worker, because the individual performance of the worker will influence the organizational performance.

2.2. Theoretical Background

2.2.1. Human Resource Management

Human Resources Management (HRM) according to the Society for Human Resources Management (SHRM, 2002a, p.2) is the design of formal systems in an organization to ensure the effective and efficient use of human talent to accomplish the organizational goals. Bratton and Gold in 2007 stated that Human Resource Management is a strategic approach to managing employment relations which emphasizes that leveraging people's capabilities is critical to achieves competitive advantage, this being achieved through a distinctive set of integrated employment policies, programs, and practices. The definition from Society for Human Resources Management and from Bratton and Gold show that the human resource management in a company holds a big impact to help the organization to achieve their goals with maintaining the effectiveness and the efficiency of the talent by emphasizing on the capabilities of the worker itself.

Figure 2.2. Functions of HRM (Mathis Robert L., Jackson John, 2011)

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The functions of HRM are:

a. Equal Employee Opportunity: Compliance with equal employment opportunity (EEO) laws and regulations affects all other Human Resource (HR) activities.

b. Staffing: The aim of staffing is to provide enough supply of qualified individual to take the jobs in an organization.

c. Talent Management and Development: It is started with the orientation of the new employees, training, developing especially for the workers, career planning of the workers in the organization, and finally performance management to assess the worker performance.

d. Total Rewards: Compensation as the rewards for the employees in form of pay, incentives, and benefits.

e. Risk Management and Worker Protection: The health and safety of the employees must be assured, and also the security, disaster and recovery planning for the employees is a must too.

f. Employee and Labour Relations: The relationship between managers and their employees must be taken care by the HRM because it is consist of the employee rights and privacy, HR policies, union/management relations. Those things will affect how the worker will doing their job.

The activities of Human Resource management are mentioned by Dessler on his 13th Editions books are as follows:

a. Recruitment, Placement, and Talent Management:
    i. Job analysis and talent management process
    ii. Personnel planning and recruiting
    iii. Employee testing and selection
    iv. Interviewing candidates

b. Training and Developing Employees:
    i. Training and developing employees
    ii. Performance management and appraisal
    iii. Managing employee retention, engagement, and careers

c. Compensation:
    i. Establishing strategic pay plans for the worker
    ii. Pay performance and financial incentives
    iii. Benefits and services for the worker and for the company

d. Employee Relations:
    i. Managing employee ethics, employee rights, and employee discipline

ii. Managing relations and collective bargaining

As stated before by The Indian Institute of Personnel Management about the scope of HRM and by Dessler about the activities of HRM, it shows the importance Human Resources Management (HRM) to the company because the scope and activities of HRM are directly affected the organizational activity from recruiting the worker (Personnel Aspect aspect) until managing the relations and collective bargaining (Industrial Relations aspect) , so it is important to the managers in the company which representing the company itself to understand the importance of the HRM. Dessler in Human Resource Management 13th Edition stated the importance of HRM for the managers, the reasons why HRM is important for the manager that is appropriate with this research are as follows:

a. Avoid Personnel Mistakes

There are several sorts of personnel mistakes that can be occurred for the managers (hire the wrong person for the job, having worker who not doing their best, wasting time with useless interviews, allow a lack of training to undermine the company department's effectiveness, and etc.), HRM will help the managers to avoid and even overcome the problems.

b. Improve Profits and Performance

HRM will give the guidance to the managers about how to hire the right people for the right jobs, motivating, appraising, and developing them by following the guidance in HRM it will help the company to improve their profits and performance. The importance of HRM are described further by Yoder, Heneman, and others, according to them there are three standpoints, they are:

a. Social Significance: Proper management of personnel enhances their dignity by satisfying their social needs. This is done by:

   i. Maintaining a balance between the jobs available and the jobseekers, according to the qualifications and needs

   ii. Providing suitable and most productive employment, which might bring them psychological satisfaction

   iii. Making maximum utilization of the resources in an effective manner and paying the employee a reasonable compensation in proportion to the contribution made by him

   iv. Eliminating waste or improper use of human resource, through conservation of their normal energy and health

   v. Helping people make their own decisions, that are in their interests.

b. Professional Significance: By providing healthy working environment it promotes team work in the employees. This is done by:

   i. Maintaining the dignity of the employee as a 'human-being'

   ii. Providing maximum opportunity for personal development

   iii. Providing healthy relationship between different work groups so that work is effectively performed

   iv. Improving the employees' working skill and capacity

   v. Correcting the errors of wrong postings and proper reallocation of work

c. Significance for Individual Enterprise: It can help the organization in accomplishing its goals by:

   i. Creating right attitude among the employees through effective motivation

   ii. Utilizing effectively the available goals of the enterprise and fulfilling their own social and other psychological needs of recognition, love, affection, belongingness, esteem and self-actualization.

In order to achieve the success of an organization, Human Resource Management has a certain role to make it possible. Prof. Prashant Mehta mention several strategic role of Human Resource Management, the roles are as follows:

a. Providing purposeful direction, the direction must be given to the people in the organization right from the beginning. The actions taken by each person must be consistent with the direction defined from the beginning.

b. Creating competitive atmosphere through cost leadership, cost leadership is establishing competitive advantage by having the lowest cost of operation in the industry. The company goals is to become low cost leader in the industry.

c. Facilitation of change, Human Resource Management focuses on substance rather than form, accomplishments rather than activities, and more important practice rather than theory.

d. Diversion of workforce, the diversity in term of male-female workers, young-old workers, educated-uneducated workers, unskilled-unprofessional workers, caste, religion and nationalities are key role that makes money is no longer a motivating factor rather it is high degree of participation and non-financial incentives, so the diversion of the workforce is a challenge and must be observed by HRM.

Barutçugil (2004) mentions the aims of Human Resource Management, according to Barutcugil the aims of HRM are:

a. To help all employees reach optimal performance and to use fully their capacity and potential

b. To convince employees to exert more effort for reaching organizational goals

c. To use human resources in an optimum way to reach organizational goals

d. To meet employees' career expectations and development

e. To unify organizational plans and Human Resource strategies and create and maintain a corporate culture

f. To offer a working environment stimulating hidden creativity and energy

g. To create work conditions stimulating innovation, teamwork, and total quality concept

h. To encourage flexibility for achieving learning organization

2.2.2. Job Description and Job Specification

Werther and Davis (1989) mention that job description is a written statement about task, working condition and any aspects that is related with a certain position in a certain job. Nitisemito (1992) also mention the definition of job description, according to Nitisemito job description is an explanation about a certain position, tasks, responsibilities, authorities, etc. Cascio (1998) states that there are five elements of job description which are job title, job activities and procedures, working conditions and physical environment, and conditions of employment. Job title is needed in order to know which job explains in the job description, job activities and procedures give a general overview for the worker about the job in a certain position, working conditions and physical environment need to show the condition and the environment that the worker will face in the job, condition of employment will lead the worker to know how the top management running the employment activity in a certain position. The conclusion from the definition above is that the job description is a written statement that give an explanation and an overview about the tasks, responsibilities, working condition, working relationship, authorities, and etc. Dessler (2013) also mention that job description and job specification can be used for performance appraisal, the figure will be shown below.
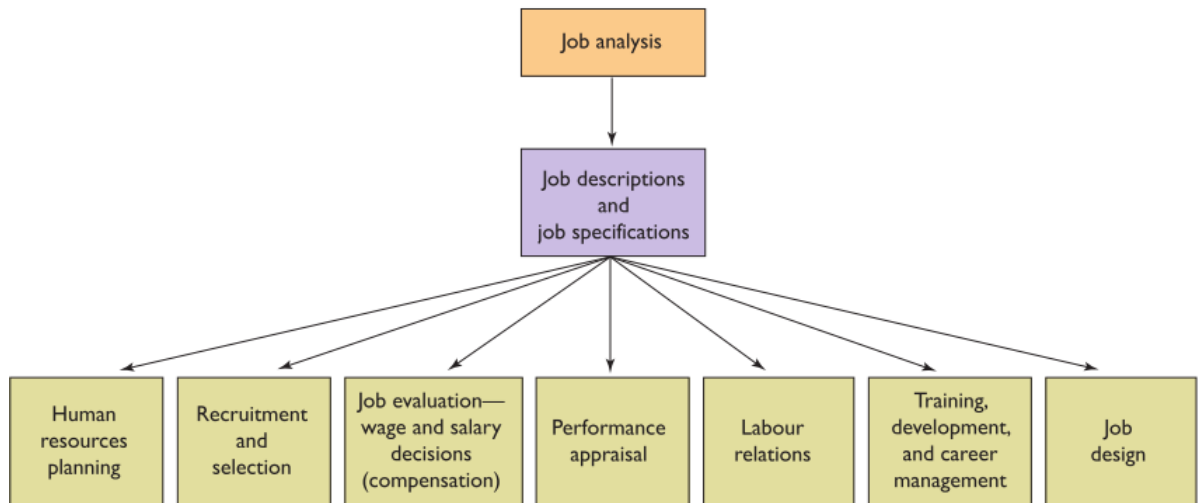
Figure 2.3. Uses of Job Analysis (Dessler, 2013)

The job description and job specification are the output of job analysis, according to Cascio the relationship of performance standards to job analysis and performance appraisal is the job analysis that has the output of job descriptions and job specifications which describes work and personal requirements of a particular job will become the performance standards. Base on Dessler and Cascio job description and job specification can become the guideline for the appraiser to know what tasks in the job is needed to perform and what skill, abilities the worker should have in a certain position. The guideline from the job description and job specification can be transform into the criteria that will use in performance appraisal instrument to help the appraiser know what criteria they will assess for the worker. The University of Illinois at Chicago Human Resources describe job description uses, the uses are as follows:

a. Employment:
    i. Workforce Planning: Job description helps in staffing requirements activity, including identify overstaffing or superfluous positions.

    ii. Candidate Recruiting, Selection and Placement: Job description provides an overview of the requirement needed to identify and choose the suitable between candidate and the job applied.

b. Acculturation and On-boarding:
    i. Orientation: The orientation for a new worker is important so the worker can do the job according to the company's needed. The job description provides an explanation to help the new worker following the job in the company.

c. Compensation:

    i. Job Families and Grades: Job description can clarify the jobs different pay levels because according to job description it will show the levels of skill, knowledge, responsibility needed to perform the job.

d. Performance Planning, Training, and Development

    i. Goal and Expectation Setting: Job description become the guideline for the worker to know the goal that has been set up by the company and the expectation of the company to the worker.

    ii. Performance Reviews: Job description determine the performance standards for the top manager to do the evaluation for the employees in order to increases the wage, promotions for the worker, opportunities for the worker, and etc.

    iii. Career Planning and Progression and Succession Planning: Job description will show about the jobs needs for specific education, experience, and skills needed in a certain job. Because of that the company can determine the jobs and employees can be facilitate in order for the succession planning process.

    iv. Training: Job description will give the worker understanding about the requirement of the jobs from that the top manager can determine the lack of the employees in a certain job and give the training to meet the requirement needed to perform the job.

e. Employment Practices

    i. Collective Bargaining: Job description can help the worker in term of pay rates, because job description can become the basis for standardizing pay rates.

Brannick et al. (2007) mentions that job specifications is a written description of job requirements. The requirement in the job specification can be physical and mental condition, education, certification, characteristic, expertise, etc. The component of job specification are as follows:

a. Educational Qualification: This component shows how qualified a person for the job by their educational aspects as the basis.

b. Experience: Job specification concern about the experience required in a certain field for completing a specific job.

c. Skills and knowledge: Skills and knowledge are really important for a job because it will help in completing the job. The higher the position of a job the more skills needed and more knowledge.

d. Personality Traits and Characteristic: This component covers the behaviour of a person in a certain situation, how to handles problems, and the emotional intelligence of a person.

Job specification has many advantages in order to help the activity of the company. The advantages of job specification are:

a. Job specification concerns on all specific details that is needed to done the job perfectly.

b. Help the top managers especially the human resource manager to know the limitation and framework on the basis that they can identify as the best possibilities for the company.

c. Job specification gives the company in choosing the applicant by choosing the closest applicant to the job specification stated by the company.

d. Human resource manager can determine the basis for evaluating the employees, and after doing the evaluation they can give the worker the trainings to meet the requirement of the company.

e. It helps the company to do the performance appraisals and give any reward for the worker.

2.2.3. Rating Scale Method

As stated before one of the activities of Human Resource Management is performance management and appraisal. In doing the appraisal for a certain company it needs a tool to help the company in doing the performance appraisal of the worker, usually the tool that is used is performance appraisal instrument. The methods that is usually used is rating scale method. According to British Columbia Institute of Technology rating scale is used for assessing the performance of tasks, skill levels, procedures, processes, qualities, quantities, or end products, such as reports, drawings, and computer programs. Rating scale are divided into 4 types which are, numerical rating scale, descriptive graphic rating scale, ranking method rating scale, and paired comparisons rating scale. Rivai and Basri (2005:357) stated that rating scale method is a performance appraisal method for a certain period of time in the past which has an advantage that can be use as the feedback to direct the effort of the improvement of the work, cheap cost in its use and improvement, assessment needs less training, easy to use, the scale is easy to understand and explain to the appraiser, from the lowest until the highest and the score of the performance of every worker can be easily use with the average score of the worker.

Sugiyono (2009) mentions about the definition of rating scale, rating scale method is a raw data that obtained in form of number that later on will be interpreted in a qualitative definition. In a rating scale method, respondent will not answer on of the qualitative answer that is already provided, but answer one of the quantitative answer that is provided. Because of that, rating scale is more flexible, it is not limited in the behavior measurement alone but also can measure the respondent perception for a certain phenomenon. Based on the definitions, rating scale method is a tool for collecting data from the respondent answer that is recorded in stages. The scale that is used in rating scale in this research with the level of measurement 1 to 4 based on Dessler (2013), the scale 1 to 4 are used to measure every criteria in the performance appraisal instrument. The scales refer to 1 = Not sufficient, 2 = Sufficient, 3 = Good, 4 = Extremely Well. The example of rating scale form model that inspire this research is based on The University of North Carolina at Chapel Hill that will be adjusted related to the need of the company. The UNC performance appraisal form contains criteria, weight, rating, and total score, and also comment space from the supervisor as the appraiser to the employee.

2.2.4. Pairwise Comparison Method

Pairwise comparison method is a method that is used in the AHP method to determine the relative weights between two criteria based on the numeric scale. Saaty stated that the fundamental numeric scale developed to distinguish the intensity between elements. The pairwise comparison scale according to Prof. Thomas L. Saaty are consists of scale 1 to 9. The pairwise comparison will be shown below in Table 2.3.

Table 2.3. Pairwise Comparison Scale

Intensity of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective.
3	Moderate importance	Experience and judgement slightly favor one activity over another.
5	Strong importance	Experience and judgement strongly favor one activity over another.
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice.
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation.
2, 4, 6, 8	Intermediate Values	The value is compromise between the above values.

The steps in doing the pairwise comparison methods are:

a. Determine importance level for every criteria based on the pairwise comparison scale, the values later on will be inputted into the form of square matrix. The ordo of the matrix is n x n, where n refers to the number of criteria.

Table 2.4. Example of Pairwise Comparison Matrix

C	A_1	A_2	$\cdots$	A_9
A_1	1	3	$\cdots$	A_{19}
A_2	1/3	1	$\cdots$	A_{29}
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
A_9	A_{91}	A_{92}	$\cdots$	1

b. Data Normalization, data normalization is calculated by dividing each values in pairwise comparison matrix with the total of the corresponding column of the numerator values. The mathematical equation for the Data Normalization calculation is:

$$\bar{A}_{jk} = \frac{a_{jk}}{\sum_{j=1}^{n} a_{jk}} \tag{2.5}$$

Explanation for the annotation:

$\bar{A}_{jk}$: Result of dividing the value of the i row of the j column with the total value of the j column

a_{jk} : Pairwise comparison value of the i row of the j column

$\sum_{j=1}^{n} a_{jk}$: Total values of the j column

c. Calculate Priority Vector, priority vector also known as eigenvector. Eigenvector shows the relative weights between the criteria that are compared. Eigenvector will lead to the eigenvalue calculation, eigenvalue shows the effect of a criteria to the characteristic of the related matrix. The mathematical equation of eigenvector is:

$$w_j = \frac{\sum_{j=1}^{n} \bar{A}_{jk}}{m} \tag{2.6}$$

Explanation for the annotation:

w_j : Eigenvector (priority vector) of j element

Ajk : Total data normalization on j column

m : Total element in a matrix

For the eigenvalue the mathematical equation as follows:

$$A \cdot w = \lambda \cdot w \qquad (2.7)$$

Explanation for the annotation:

A   : Matrix

w : Eigenvector

λ : Eigenvalue

d. Consistency Evaluation

In this step it calculates the consistency of the decisions, the decisions here are the decision from the expert in term of the judgment for the importance of every criteria using the values from pairwise comparison scale from Saaty. The step calculates the overall consistency of the expert judgment by means of a consistency ratio. Saaty (2012) has shown that the value of the consistency ratio 10% or less is acceptable, if the consistency ratio is above 10% it necessary to revise the judgment from the expert.

  i. Determine λmax

    The mathematical equation for calculating λmax is:

$$\lambda \max = \frac{\sum_{j=1}^{n} \lambda}{n} \qquad (2.8)$$

ii. Calculate Consistency Index (CI)

$$CI = \frac{(\lambda_{max} - n)}{(n-1)} \qquad (2.9)$$

Explanation for the annotation:

CI   : Consistency Index

λ_{max} : Maximum Eigenvalue

n   : ordo matrix number

iii. Calculate Consistency Ratio (CR)

The consistency ratio can be calculated with the mathematical equation as follows:

$$CR = CI/RI \qquad (2.10)$$

Explanation for the annotation:

CI : Consistency Index

RI : Random Index

Random consistency index according to Prof. Thomas L. Saaty, Alonso-Lamata, and Liem T. Tran are stated on the table below.

Table 2.5. Random Consistency Index (RI)

Ordo Matrix (n)	RI
1	0
2	0
3	0.52
4	0.89
5	1.11
6	1.25
7	1.35
8	1.40
9	1.45
10	1.49
11	1.52
12	1.54
13	1.56
14	1.58
15	1.59