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Analysis of Employee Work Stress Using CRISP-DM to Reduce Work Stress on Reasons for Employee Resignation

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ABSTRACT

Internal audit activities at one of EPC companies have found a trend of increasing work stress as a reason for employee resignation in the period Q4 2021 - Q1 2023. In implementing ISO 45001:2015 this must be controlled because it is tend to a psychological occupational disease. For this reason, a work stress survey was carried out. The results of which were reviewed using Cross Industry Standard Process for Data Mining (CRISP-DM). Descriptive analysis found two factors that influence the level of work stress, namely demands for work quality and taking responsibility for other people's work results. More specifically, the level of work stress is because employees are required to exceed their capabilities but at the same time have to help other people solve problems. Apart from that, based on Cluster analysis, 2 optimal clusters were found. Cluster-1 has a moderate stress centroid for overall work stress factors. Cluster-2 has a light stress centroid for the overall work stress factor. The recommendation for controlling work stress in cluster-1 is to prepare a program to increase employee competency and improve the performance measurement system. Controlling work stress cluster-2 is annual monitoring through employee work stress surveys.

Keyword: Work Stress, Descriptive, Diagnostic, K-Modes Clustering, SECI

ABSTRAK

Kegiatan audit internal di salah satu perusahaan EPC telah menemukan tren meningkatnya stres kerja sebagai alasan pengunduran diri karyawan pada periode Q4 2021 - Q1 2023. Dalam implementasi ISO 45001:2015 ini harus dikendalikan karena cenderung menjadi penyakit psikologis kerja. Oleh karena itu, dilakukan survei stres kerja. Hasilnya ditinjau menggunakan Cross Industry Standard Process for Data Mining. (CRISP-DM). Analisis deskriptif menemukan dua faktor yang mempengaruhi tingkat stres kerja, yaitu tuntutan untuk kualitas kerja dan tanggung jawab atas hasil kerja orang lain. Lebih khusus lagi, tingkat stres kerja adalah karena karyawan diminta untuk melebihi kemampuan mereka tetapi pada saat yang sama harus membantu orang lain memecahkan masalah. Selain itu, berdasarkan analisis Cluster, 2 cluster optimal ditemukan. Cluster-1 memiliki centroid stres moderat untuk faktor stres kerja secara keseluruhan. Cluster-2 memiliki centroid stres ringan untuk faktor stres kerja secara keseluruhan. Rekomendasi untuk mengendalikan stres kerja di cluster-1 adalah untuk menyiapkan program untuk meningkatkan kompetensi karyawan dan meningkatkan sistem pengukuran kinerja. Pengendalian stres kerja cluster-2 adalah pemantauan tahunan melalui survei stres kerja karyawan.

Keyword: Stres kerja, deskriptif, diagnostik, K-mode clustering, SECI

1. Introduction

All companies that engage in construction services such as Engineering, Procurement and Construction (EPC) must be based on security and safety aspects [1]. There are two types of safety and health certificates

that are applied in Indonesia such as certificates with International Standards, namely International Organization for Standardization (ISO) 45001:2018, and National Standard, namely Occupational Health and

Safety Management Systems (SMK3). One form of assessment to maintain the competency certificate is that the organization must carry out internal audit activities [2].

One of the risk findings obtained was in the Human Resource function, namely an increase in the amount of employee work stress as a reason for employee resignation. Work stress is an occupational disease in psychological terms that can lead to unsafe behavior at work [3,4,5,6,7]. This reason for work stress has dominated the factors causing employee resignations since Q4 2021 – Q1 2023 as below:



Figure 1. Trends in employee resignation data due to stress and non-stress (Source: Internal Data)

This situation makes productivity decreasing. Of course, the most troublesome thing is finding replacement employees. This situation has hidden costs that shown below:



Figure 2. The impact this has on the employee recruitment process (Source: Ashutosh, 2018)

These risk findings must be controlled and reported by Management Representative (MR) team so that the MR team must prepare an improvement program to anticipate a spike in employee resignations due to stress factors in the next period[8].

2. Methods

Many models have been developed to measure work stress with the aim of controlling the number of employee resignations. Starting from researchers' opinions for dependent and independent proof, or which have been developed by adding the Delphi method (collection and validation of expert opinions) combined with decision analysis. However, not all methods are universally applicable. Methods must be adapted to the problem and context faced.

This research uses an EHS approach based on Ministry of Manpower Regulation (PERMENAKER) Number 5 of 2018 [9]. The survey data obtained will be subjected to descriptive and diagnostic analysis as exploratory data analysis, and then following the Cross Industry Standard Process for Data Mining CRISP-DM) framework with cluster analysis modeling. It is hoped that the results of this research will be able to provide policy recommendations for controlling work stress through Focus Group Discussions (FGD) which will produce recommendations for controlling work stress so that it does not interfere with company productivity. Another contribution is also in response to the implementation of ISO 45001:2018 and SMK3 towards the absorption of applicable government regulations.

2.1. Data collection

The Stress Diagnosis Survey (SDS) containing 30 questions with six stress indicators such as:

- 1. Role ambiguity, namely pressure that arises due to feelings of ambiguity in roles or responsibilities.
- 2. Role conflict, namely the pressure that arises when an employee has to face a conflict between conflicting demands or expectations in his or her role or responsibility.
- 3. Qualitative workload, namely the pressure that arises when employees feel inadequate or unskilled in completing the tasks given.

- 4. Quantitative workload, namely pressure that arises due to workload that is too heavy or too much in a limited time.
- 5. Career development, namely the pressure that arises when employees feel that their career development is hampered or does not meet expectations.
- 6. Responsibility towards others, namely the pressure that arises when employees feel responsible for other people, such as a team or work group, and feel they have to ensure that their work is done well.

Each questionnaire will be given seven values (categorical) with the following value conditions:

- 1. Score (1), if the conditions described never cause stress
- 2. Score (2), if the conditions described low rarely cause stress
- 3. Score (3), if the conditions described rarely cause stress
- 4. Score (4), if the conditions described sometimes cause stress
- 5. Score (5), if the conditions described low often cause stress
- 6. Score (6), if the condition described often causes stress
- 7. Score (7), if the conditions described always cause stress

After filling in, the next step is to carry out a scoring system like the table guide.

Table 1. Stress Fact	ors Based on Minister of Manpov	wer Regulation Number 5 of 2018
Assessment	Information	Score Sums of Questionnaire
Score of TP	Role Ambiguity	1+7+13+19+25
Score of KP	Role Conflict	2+8+14+20+26
Score of BBKuan	Quantitative Workload	3+9+15+21+27
Score of BBKual	Qualitative Workload	4+10+16+22+28
Score of PK	Career Development	5+11+17+23+29
Score of TJO	Responsibility Towards Others	6+12+18+24+30

Conclusion of score of sums of questionnaire:

Score $\leq 9 =$ LIGHT stress; Score 10-24 = MEDIUM stress; Score > 24 = SEVERE stress

2.2. CRISP-DM

CRISP-DM has six main stages [10] as below figure.



Figure 3. CRISP-DM Framework

Source: <u>https://www.ibm.com/docs/it/spss-modeler/saas?topic=dm-crisp-help-overview</u>

- 1. Business Understanding, namely this stage involves understanding the business problem that you want to solve using data mining. At this stage, define business goals and success criteria.
- 2. Data Understanding, namely this stage involves understanding the data available to solve business problems. At this stage, relevant data is identified and collected, and data exploration (Descriptive and Diagnostic Analysis) is carried out to determine the characteristics and quality of the data.



Figure 4. Risk Matrix

Source: https://safetyculture.com/topics/risk-assessment/5x5-risk-matrix/

- 3. Data Preparation, namely this stage involves preparing data for further processing. At this stage, data selection, data cleaning, data transformation, and data sample creation are carried out.
- 4. Modeling, this stage involves developing a model that will be used to solve business problems. At this stage, appropriate method selection, model formation, and model testing are carried out. This research uses Clustering K-Modes Algorithm as unsupervised learning.



Figure 5. System Modeling in CRISP-DM

Source: https://resources.experfy.com/ai-ml/coding-deep-learning-for-beginners-types-of-machine-learning/



Figure 6. Categorical Cluster Algorithm Classification [11] Source: (Aggarwal & Reddy, 2013)

- 5. Evaluation, namely this stage involves evaluating the results obtained from using the model. At this stage, an evaluation is carried out on model performance, suitability of the model to business needs, and risk analysis.
- 6. Deployment, namely this stage involves implementing the model in a business environment. At this stage, the model is integrated into the business system, and continuous monitoring and improvement of the model is carried out. SECI was chosen because of work stress related to knowledge scope.



Figure 7. SECI Framework [13]

Source: (Mendoza, Norman B.; Cheng, Eric C.K; Yan, Zi;, 2022) from (Cheng, Eric C.K;, 2018)

3. Results

3.1. Data Exploration

A. Descriptive Analysis

The descriptive analysis stage aims to determine the phenomena that occur. This use storytelling which is communicating information by combining data, narrative, and visualization [14]–[16]

1. Based on Demography of Respondent



Figure 8. Demographic of Respondent

The results of the descriptive analysis are focused on "PIC" because it is clear based on the organizational structure who is the superior. If it is compared to the other five profiles, it will mix and create bias [17].

2. Based on Respondent Demographics on the resulting employee work stress values

Table 2. Matrix of PIC Job Stress Levels against Job Stress Factors



The level of moderate stress was in the range of 60% - 66%, meaning that there were 6 to 7 people with moderate stress out of the 10 people surveyed. Severe stress is in the range of 1% - 9%, meaning that there are 1 to 9 people with severe stress out of 100 people surveyed.



Moderate			10	Contequence			- Severe		Consequence					
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Likely	4	-4	8	11			Likely	4	+	-1	143			
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10111111111111111111111111111111111111		- m) 2	dodeente S	teras Matrix.					10.	Severe Str	ess Materia			

We plot using table risk evaluation matrix and we got both Medium and Severe are in Yellow Area. It means we have to control the work stres [18].

3. Based on Respondent Demographics on the resulting employee work stress values

Respondent			11 110		90		100% 100% 10%	6 Sbess 1	5 Stress 1
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Figure 9. Distribution of Severe Stress

Pareto's results are a focus on qualitative workload, responsibility for others, career development, and quantitative workload.



Figure 10. Distribution of Moderate Stress

Pareto's results are a focus on quantitative workload, qualitative workload, career development, role conflict, and responsibility towards others.

B. Diagnostic Analysis

This diagnostic analysis uses data drilling techniques, namely exploring the sub-factors of each work stress factor so that it can be seen why the work stress factor is so influential [19].

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Figure 11. Distribution of average questionnaire scores

Table 4. Pareto Effects of the Work Stress Questionnaire (SEVERE)

	lost influential	Number of	5	Aggregate Batio	Nut Infuntial Questionaby	Contario (Severa Ura	ng Value to Scote + 241
	Factor	Amponiants	Sate	(Pareto)		Modes	Agg. Meetin
П					4 Juan asked a lot about the quality of work	7	3
	a state				18 As the days go by, my tasks become more complex		1.1
4	Quantative	28	29%	25%	32 The organization expects me to be able to encoud my abilities		19
	Antergoong				10 The tasks given to me are sometimes too difficult and/or too complex		25
					28 Flack the transing and/or experience to adequately perform my duties	4	29
					12 fan respondble for guiding and/or helping my subantitutes some work related problems	7	2
	Responsibility	- 10	205	55%	18 in my job, i make several decisions that can affect the safety and well-being of others		13
	towards Differs				28 My responsibilities in this organization relate more to people than to things	7	20
					# It am responsible for the development of other employees	8	25
				1	10 Lars responsible for other people's career paths	5	30
Т					17 It after think that my career progress has been hampered by this organization	1	. 3
					29 i feel hampered in advancing my cases	7	- 54
4	Career		in the	75.56	5 There are less apportunities for me to develop in this argumentian	X.	- 21
1	development	1000	-		25 There few opportunities to descripp and learn new knowledge and skills in my pob	•	21
					11 F1 move up a position, I can move to adorber department	2.0	21
Τ					12 At the same time, 1 are expected to be able to evaluate and be responsible for a method of work projects		1
Ы	Quantitative	1.1	144	22	21 I really have more work than can usually be done in a day	7	34
1	Workload		19.0	9809	3 There to take my work home every evening or weekand to make up time.	<i>t</i> .	21
					27 It find it difficult to take annual leave		29
					I spend too much time on unimportant meetings that take up my work time	ž.	29
					20 There are some of my works that are understood by one person but not by another		
4	4012000431	5.4.5	1.44	200	26 Treasive conflicting requests from one or more people		11
1	ADDE CONTROL		104	9676	2. Twork on tasks or projects that do not fit the job description	3	18
					8 Lars in the gray tone between my superiorit and my subordinates	6	- 24
					14 Many formal work orders are not obeyed	\$	29
1					13 Wy extherity is limited in carrying put my job responsibilities	7	1
					1 The targets of my work alo not match the job description	+ -	
4	Role Ambiecov	1.00	100	10075	7 There is no clarity to whom I should report the results of the work	+ :	
1	over second and			C sector :	19 I didn't understand what the organization expected of me		
					25 In terms of overall organizational goals, I don't understand the part of the job that I have to do	4	1.11

 Table 5. Pareto Effects of the Work Stress Questionnaire (MEDIUM)

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Table 6. Recap of Questionnaire That Influences Job Stress



There are 19 questioners that affected job stress moderate and severe. 12 questioners (63%) that influence both Moderate Stress and Severe Stress (Green Marked). Then we can see the sorting contribution of stress level as shown on Table 7 as below:

 Table 7. Sorting Contribution of Severe Stress Level and Moderate Stress Level

o	1
ð	2

	Severe Stress	Moderate Stress
9%	Qualitative Overload	66% Qualitative Overload
\$75	Responsibility Towards Others	66% Quantitative Overload
6%	Career Development	63% Career Development
5%	Quarvitative Overload	60% Responsibility Towards Others
2%	Role Conflict	60% Role Ambiguity
1%	Role Anibiguity	62% Role Conflict

It shown that qualitative workload factors dominate. So, it can be seen that "I am asked a lot about the quality of my work" and "I am responsible for guiding and helping subordinates solve their problems".

3.2. Modelling - Unsupervised Learning use Cluster K-Modes

Use python software with elbow will get 2 clusters optimal that shown as Figure 13 below:



Figure 13. Determination of Optimal Clusters

Then use K-Modes algorithm to separate those clusters which shown on Table 8 below:

Table 8. Clusters formed through K-Modes

	Bule Asbiguity	Ails Covflict	Quetitative sorkload	Qualitative morehous	Carver Development	Responsibility Towards Others	distor
. 6	2. Moderate Stress	2. Moderate Stress	2. Modelary State	2. Moderate Stream	2 MODELER (Rama	2 Moterine Stress	0
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342.4	au + Frankersa						

It can be seen that each data has a cluster identification in the table on the right column. For example, data lines 0 - 4 are cluster-0, data lines 238 - 240 are cluster-1.

The data distribution is formed as shown in Figure 14 below:

C.m+1	Cum-2			
-		10.176	67 205	

Figure 14. Distribution of Cluster-1 and Cluster-2

The data center (centroid) of segment-1 and segment-2 looks like Figure 4.15 below:



Figure 15. Centroid of Cluster-1 and Cluster-2

It can be seen that segment-1 has the entire centroid of moderate stress data. Segment-2 has the entire centroid under mild stress.

3.3. Evaluation

This part explains information by exploring the data by cluster on each profile.

a. Based on Level



Figure 14. Cluster information by Level

Information:

- a. For the "staff" level, there are 92 people (69%) in segment-1 (moderate stress) and 41 people (31%) in segment-2 (light stress).
- b. For the "senior staff" level, there are 41 people (77%) in segment-1 (moderate stress) and 12 people (23%) in segment-2 (light stress).
- c. For the "section head" level, there were 24 people (71%) in segment-1 (moderate stress) and 10 people (29%) in segment-2 (light stress).
- d. For the "department head" level, there are 12 people (92%) in segment-1 (moderate stress) and 1 person (8%) in segment-2 (light stress).
- e. For the "division head" level, there are 5 people (83%) in segment-1 (moderate stress) and 41 people (17%) in segment-2 (light stress).
- f. For the "group head" level, there is 1 person (33%) in segment-1 (moderate stress) and 2 people (67%) in segment-2 (light stress).



Figure 15. Cluster information by Age

Information:

b. Based on Age

- a. For those aged "26-41", there were 133 people (74%) in segment-1 (moderate stress) and 47 people (26%) in segment-2 (light stress).
- b. For age "≥ 41", there were 27 people (69%) in segment-1 (moderate stress) and 12 people (31%) in segment-2 (light stress).
- c. For age "≤25", there are 15 people (65%) in segment-1 (moderate stress) and 8 people (35%) in segment-2 (light stress).

c. Based on Gender



Figure 16. Cluster information by Gender

Information:

- a. For the "male" gender, there were 130 people (71%) in segment-1 (moderate stress) and 53 people (29%) in segment-2 (light stress).
- b. For the "female" gender, there were 45 people (76%) in segment-1 (moderate stress) and 14 people (24%) in segment-2 (light stress).
- d. Based on Marriage Status



Figure 17. Cluster information by Marriage Status

Information:

- a. For marital status "married", there were 115 people (72%) in segment-1 (moderate stress) and 44 people (28%) in segment-2 (light stress).
- b. For marital status "not married", there were 58 people (72%) in segment-1 (moderate stress) and 23 people (28%) in segment-2 (light stress).
- c. For the marital status of "widower", there is 1 person (100%) in segment-1 (moderate stress) and 0 people (0%) in segment-2 (light stress).
- d. For the marital status "widowed", there is 1 person (100%) in segment-1 (moderate stress) and 0 people (0%) in segment-2 (light stress).
- e. Based on Working Period



Figure 18. Cluster information by Department

Information:

- a. For work period "≥ 11", there were 158 people (72%) in segment-1 (moderate stress) and 61 people (28%) in segment-2 (mild stress).
- b. For the work period "6-10", there are 9 people (75%) in segment-1 (moderate stress) and 3 people (25%) in segment-2 (light stress).
- c. For the "0-5" work period, there were 8 people (73%) in segment-1 (moderate stress) and 3 people (27%) in segment-2 (light stress).

D. Deployment

Of the 19 questionnaires that have the most influence on moderate and severe work stress factors, the next step is to formulate work stress control using the S-E-C-I technique as follows [13], [23].

	Questionnaire	SOCIALIZATION (tacit-to-tacit)	EXTERNALISATION (tacit-to-explicit)	COMBINATION (explicit-to-explicit)	INTERNALISATION (explicit-to-tacit)
15	At the same time, 1 nm expected to be able to multitask and be responsible for a number of work projects	The supervisor explains the business background, competition issues and competencies	1		Learn from webinars, other digital materials about how to multitask
22	The organization expects me to be able to exceed my abilities	The supervisor explains the business background, competition and competency issues and opportunities for promotion	5)	17	Learn from webinars, other digital materials regarding increasing competency
21	I really have more work than can usually be done in a day	Superiors together with HR verify Workload Analysis, opportunity to improve work processes		i de la compañía de	Learn from webinars, other digita materials regarding work priority scales (Important and Urgent)
12	I am responsible for guiding and/or helping my subordinates solve work- related problems	Provide clarity on the main tasks and functions that must be carried out routinely, and carry out periodic performance measurement	Create standard operating procedures (SOP) and work instructions (specific work documents)	14	Ask subordinates to read and implement the SOP and work documents
16	As the days go by, my tasks become more complex	Superiors together with HR verify Workload Analysis, opportunity to improve work processes	51	27	(1 <u>8</u>)
4	I am asked a lot about the quality of work	The supervisor explains the business background, competition and competency issues and opportunities for promotion	5 3		Learn from webinars, other digital materials on how to focus on quality of work
18	In my job, I make several decisions that can affect the safety and well- being of others	The superior explains that work must be based on procedures and he professional	₹.1	8	1289
20	There are some of my works that are understood by one person but not by another	The supervisor provides an explanation regarding the uniquentess of the job which requires unique skills	Crente standard operating procedures (SOP) and work instructions (specific work, documents)	1	020
6	I am responsible for the development of other employees	The boss explained that the job would be easier if it could be done together	R)	34	30 8 3
24	My responsibilities in this organization relate more to people than to things	The boss explained that currently administrative work is not fully covered by disitalization	2)	3	(a)
2	I work on tasks or projects that do not fit the job description	The supervisor must clarify the job with the job description from the HRD team. If necessary, adjustments must be made to the dimensions of work and worker compensation	5	a	12
23	I have few opportunities to develop and learn new knowledge and skills in my job.	The boss directs process improvements (innovation) in his work. This can be developed by increasing creativity and knowledge	Ľ	а.	(suit
29	I feel hampered in advancing my career	Superiors and HR formulate employee career advancement programs, then provide outreach to all employees	εi	la.	() ()
26	I receive conflicting requests from one or more people	Superiors together with HR cluify work according to the organizational hierarchy and do not violate the company's code of ethics		9	(61)
17	I often think that my career progress has been hampered by this organization	Superiors and HR formulate employee career advancement programs, then provide outreach to all employees	20	2	020
3	I have to take my work home every evening or weekend to make up time	Superiors together with HR verify Workload Analysis, opportunity to improve work processes	20	Ϋ́ι.	(7 2 -)
5	There are few opportunities for me to develop in this organization	Superiors and HR formulate employee career advancement programs, then provide outreach to all employees	Ξ.	<u>s</u> .	141
10	The tasks given to use are sometimes too difficult and/or too complex	Provide clarity on the main tasks and functions that must be carried out routinely, and carry out periodic performance measurement methods	Crente standard operating procedures (SOP) and work instructions (specific work documents)	3	Study and implement the SOP / work document
27	I find it difficult to take annual leave	Superiors must inform subordinates about the do's and don'ts of leave time	Ħ	54	1949

Table 8. SECI Formulation of 19 Influential Questionnaires

4. Discussion

- 1. Efforts to find factors that cause work stress through descriptive analysis, diagnostic analysis and clustering analysis approaches. Descriptive analysis provides information that "demands for job quality" and "taking responsibility for the results of other people's work" are the biggest factors in work stress levels. Diagnostic analysis provides information that the variables "demands exceed capabilities" and "having to help other people solve problems" are the main causes of work stress levels. Clustering analysis divides the data into two segments, namely the moderate stress segment where the overall level of factors causing work stress is moderate stress, and the mild stress segment where the overall level of factors causing work stress is mild stress.
- 2. Recommendations as implications for the organization, namely the medium stress segment, will create a policy that focuses on controlling qualitative workload by implementing individual competency improvement programs. Meanwhile, the factor of taking responsibility for other people's performance will be carried out by implementing a performance appraisal system modification program to additionally evaluate employees' ability to help complete co-workers' tasks. For the mild stress segment there is no special program, only annual monitoring is carried out by filling out employee work stress surveys and asking for input and suggestions.

5. Conclusions

Work stress measurement studies guided by Minister of Manpower regulations are able to show factors that cause work stress in the work environment. However, these findings must be confirmed by the actual conditions in the company when an employee submits his resignation.

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