



Human Factor on Automotive

Component Manufacturing in Malaysia

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Abstract

The purpose of this study is to identify and describe the perceptions of experts on the characteristics of beltline moulding quality success factor. This study was done through questionnaire and interview with 14 experts in the roll forming process. From this study we found; first, the experts placed attributes such as salary satisfaction, training and skill requirement and workplace environment. Second, the study look at correlations between the independent variables which is we found five positive or negative significant whereby quality improvement awareness have strong positive significant ($p\text{-value} = 0.001$) with quality of beltline moulding for local automotive. From the study understanding what the experts want in their essential and satisfactory may enhance the probability of getting the high quality in beltline moulding product.

Keywords: Experts, Roll forming process, Beltline moulding, Interview

1. Introduction

A few research problems are usability and man-machine interface are among the pressing issues we are facing today in dependable systems. The Production process of dependable systems, from requirements specification to implementation, requires continuous interactions between the activities at the different stages with the validation and verification of each step. Challenging issues in validation of complex systems are design integration, composition, re-use and usability.

To produce goods and services requires resources. We call these the factor inputs available in the production process. Economic resources are scarce relative to the infinite needs and wants of people and businesses operating in the economy. It is important to use these resources efficiently in order to maximise the output that can be produced from them. Labour is the human input into the production process.

Human factors gave the dependability of a system is heavily influenced by the dependability of the man-machine interaction. It is necessary to introduce “human in the loop” as a design pre-requisite. Continuous interaction between user and system, as a consequence of two aspects of a new generation of interacting systems: ubiquity and invisibility. Human behaviour is more unpredictable than any conventional fault model. Is it better to adopt a defensive strategy that constrains what the user can do to perturb the operations or should one design around all foreseeable situations? It is difficult to constrain users to adopt a simplified behaviour that characterizes a state of technological awareness. There is a need for the systems to adapt to users, to be aware of their operating context, and to be able to take autonomous decisions to some extent.

Human dependency on the correct behaviour of systems in many (if not all) aspects of everyday life has a growing impact. In safety critical systems, it is important to extend formal techniques to explicitly consider human factors within

the design and assessment processes. Again, the concepts of usability and man-machine interface are central in this area and will be a leading research problem (A. Bondavalli et al., 2002).

2. Previous Studies On Industrial Workers

Whist some research on industrial workers has been conducted, much of it has emphasized observing and reporting certain characteristics, but not on issues such as factors that can influence workers performance. In general, previous studies on industrial workers focused on observing and following three areas: a) demographic characteristics of industrial workers; b) industrial working environment; and c) phenomena from shift work.

The survey of the industrial workers literature suggests that many of previous study mainly emphasized observing and reporting the demographic characteristics of industrial workers such as marital status, age and shift work. Past study found that marital status was strongly linked to the taking of sick leave. Age, work schedule, and duration of work in the factory were significant confounders only in certain cases. While, parts assembly workers also faced significantly higher odds of taking sick leave (HL Chee & KG Rampal, 2003)

Similarly, past studies on industrial workers also examined and described the problems and constraints of their working environment. Most of these studies agreed about the common problems and constraints faced about heat, ventilation and lighting. Heat was found to be a problem primarily in the moulding processes as well as in the burn-in testing areas; while radiation was contained in a few specific areas. Poor ventilation and lighting was noticeable only in very few areas, primarily in the smaller plants (HL Chee & KG Rampal, 2003).

A study by (Smith, L. et al., 1998) tested nurses and industrial workers and recommended matching shift work to human circadian rhythms in order to prevent sleep loss when not working. Meanwhile, (Smith, L. et al., 1998) developed a process model of adaptation to shift work, which looked at sleep, social, and domestic disturbances for both nurses and a sample of industrial workers. The model specifically proposes that individual differences in personality, age and situational workload variables will negatively influence sleep, family, and social life. This model was tested with self-report data. (Smith, L. et al., 1998) measured 8 and 12 hour shifts to determine the optimal length of a shift. They found no significant differences between the two shifts except as they may affect specific individuals, although their results were somewhat equivocal.

Moreover, Fletcher, A. and Dawson, D. (2001a) found a significant main effect for predicted fatigue scores and start or end of shift, shift duration and time of day. Fatigue scores were significantly higher at the end than beginning of shift and fatigue scores were greater for longer shifts. They also found that fatigue scores were highest for shifts beginning between 0000 and 0800, next highest for beginning between 0800 and 1600, and the lowest were for shifts beginning between 1600 and 2400. They concluded that “shift duration should always be interpreted relative to the time-of day that it is occurring”.

3. Methodology

The survey reported here was carried out using personal contacting the respondents' survey methodology. The questionnaire was sent to selected respondents' with direct to the respondents at the roll forming process plant. Respondents were asked to complete each of the six sections and submit the responses through researcher.

3.1 Survey Development

The questionnaire was developed based on the responses to the questions in the pilot survey and discussions within the assistant manager and supervisor which involve in roll forming process. The two overriding concerns raised were the survey length and the suitable questions in obtaining appropriate data for the research questions. The survey question selection process led to a reduction in the number of questions relating to the respondents' personal and working information and helped identify a reduced set of issue specific questions that would not only meet the survey requirements, but the overall project objective as well. In the end, the final survey was reduced in size considerably to a four pages document, which minimized the effort required by respondents (Hair, JF et al., 1998)

3.2 Sample Size

The exploratory nature of the study and the lack of empirical data to establish the effect size resulted in the adoption of a convenience sampling approach (Diane Bone and Rick Griggs. 1989). This approach involves collecting information about the population from a sample that is able to provide it. Questionnaires were distributed to 14 experts from Roll Forming Department in the industry. The respondents were practitioners who had the responsibility of enhancing performance through the quality and number of production for roll forming process.

3.3 Analysis Methodology

A preliminary analysis plan was prepared with the research objectives in mind and based on the pilot survey and discussion analysis. This ensured appropriate data was collected, particularly when considering likely differential

factors. Development of the analysis plan also helped in limiting the questions asked thus reducing the burden on the respondents.

The response types were generally ordinal or nominal. However, the category scales used were chosen to allow responses to be treated as interval (continuous) data, thus enabling use the more powerful statistical tests to be carried out, where deemed useful. Both parametric and non-parametric tests were carried out on most question responses to check that the analysis results weren't spurious. Parametric tests are more statistically powerful than their non-parametric counterparts; however, for them reliable, certain underlying assumptions need to be met. The responses were tested to determine how well they met the basic underlying assumptions of normally distributed responses and equal variance. For normally, the data was subjected to Chi-squared test of normality were used.

A total 14 experts from Roll Forming Department in the company participated in the study. Each of these respondents was presented with a set of questionnaire containing a list of relationship between roll forming production operator with beltline moulding quality. The respondents were surveyed using a structured questionnaire made up of six parts. Part 1 measures the respondent's demography. All question for this part in nominal variable. Part 2 measures the respondent's satisfaction on current salary. Part 3 asked to respondent about training and skill enhancement requirement for them. Part 4 questions on workplace environment and Part 5 measures the level of respondent's awareness to beltline moulding quality. All question for Part 2 to Part 5 in ordinal variables. We used Likert scale as a tool for measurement. Likert Scales are considered a misnomer by some, as their ordinality refers only to an ordinal relationship of values within a single item. We used Likert scales in our survey because that scales are by far the most common type of survey item, in which we design response categories are "strongly agree", "agree", "disagree", and "strongly disagree". These values are ordinal within any given Likert item but sets of Likert items are not necessarily ordinal with respect to each other. Meanwhile, Part 6 we design interview questionnaire asked to respondents about their overall perspective about roll forming process in the company.

Descriptive statistics in the form of frequency and univariate analysis were performed to describe the response data. Measures of association used predominately correlation analysis. Spearman's Rho, which is a measure of the correlation of the ranks of the data rather than the values. While, Somers'd, which is a measures of association between two ordinal variables that ranges from -1 to 1. Like correlation analysis, values close to an absolute value of 1 indicate a strong relationship between the two variables, and value close to 0 indicate little or no relationship between the variables with a positive statistic indicating a positive relationship. Measures of differences used predominately Chi-squared tests. These tests are non-parametric tests. The significance level for the tests was nominally at the 0.05 level. All tests were two-tailed, looking for any difference in the statistic concerned. The statistical analysis was carried out using SPSS statistical analysis package together with Microsoft Excel.

3.4 Data

Prior to analysis, the survey data was put through a process of data cleansing where every question was checked to ensure the response was of the appropriate type or consistency. On the other hand, all relevant questions were completed and duplications were identified which is after verification it's removed. Missing values were ignored rather than imputed and only valid answers to a question were analysed. That meant the sample size differed between questions and it might be difficult to draw inferential conclusions about the population. The data was then coded for analytical purpose.

3.5 Validity and reliability considerations

Reliability analysis of the items measuring job satisfaction, working environment and quality awareness were performed to evaluate the Cronbach's Alpha value, which shows a value 0.66. The reliability test results in this study show alpha values exceeding 0.60 to 0.70 recommended by Hair,JF, Anderson et al (1995) as the lower limit of acceptability. This ensures that the items grouping is reliable under the conditions of the local survey.

4. Findings of the Study

4.1 Respondent Profile

This section looks at the respondent profile. Knowledge of respondent profile allows the identification of categories for further analysis. To gain the required respondent demography the four areas were investigated through survey are respondent's gender, age, marital status and education. In all 14 respondents from roll forming experts registered and completed the survey. This represents a response rate of 100%, which is considered all the experts response for this survey. Each respondent was asked to complete contact details for the purpose of response verification if required. This information was also used to identify the respondent's gender. The all respondents were men and no have any women. Secondly, respondents were asked to indicate the age level. Of those who responded, 50% had age from 26 to 30 years old, age less than 25 years old (36%) and range age from 31 to 35 years old with 14%. Third, discuss to marital status shows the majority (64%) of respondents were married and rest of them still single. Finally, respondents were asked to

indicate the highest level of education completed from a defined list of response. Only one respondent had skill certificate and 79% had some form of tertiary qualification.

4.2 Respondent Work Profile

In this section of the questionnaire the respondents were asked about their work shift they were involve which is we found the largest proportion (86%) of respondents had work in three work shift. Respondents were asked to indicate how long in hours they have been working for overtime in their present position everyday. Half of respondents had one hour working for overtime in everyday and 36% had take overtime for everyday. Respondents were asked to indicate their salary per month which is the majority (86%) of respondents earn between RM501 to RM1,000 a month and 14% respondents earn RM1,001 to RM1,500. In terms of the respondents' overtime's allowance, of those who indicated their overtime's allowance, 86% earn less than RM500 a month while 14% earn between RM501 to RM1,000 a month. For the final question in this part, respondents were asked to indicate supposing that had any part time job after working hours. All the respondents said they not have any part time job after working.

5. Results and Discussions

5.1 Survey analysis results

A pilot study was conducted to test the structured questionnaire adopted in the study. By using the structured questionnaires, the data were gathered through face-to-face interviews with 14 experts of the company's selected. Responses were scored as positive or negative values. Null responses were regarded as negative values. A database was created using SPSS package and EXCEL to analyze the data. In addition to proportions and percentages used to describe the data, chi-squared significance, Fisher exact and Spearman rho correlation coefficient tests were used for analysis, with $P < 0.05$ considered statistically significant.

Completed questionnaires were received from 14 experts which scores for 25 questions and five questions in interview are shown in Table 1.

The correlation coefficients between both the independent variables in the group such as respondent's demography (variables D1-D8), respondent's satisfaction on current salary (I1-I5), respondent about training and skill enhancement requirement (W1-W4), workplace environment (E1-E4) and respondent's awareness to beltline moulding quality (Q1-Q4) are tabulated in Table 1. From the table, it can be seen that each variables are positively and negatively correlated to some variables. When we select variables have significantly at $p < 0.005$ we found some observations are presented in table 2 as shown below.

Table 2. Summary of Significant (2-tailed), $p < 0.005$

	D2	D6	I1	I5	Q1
D6	-0.786** (0.001)				
W3				0.730** (0.003)	
E1			0.732** (0.003)		
Q2					0.800** (0.001)
Q3		0.731** (0.003)			

Note: ** Significant at $p < 0.005$

The summary of the result analysis is depicted in Table 2 represents as:

- (1) Respondent's age (D2) significantly leads to negative impact on respondent's monthly salary (D6).
- (2) Respondent's monthly income (D6) significantly leads to positive impact on low material quality for beltline moulding production cause high rejection number (Q3).
- (3) Respondent's income enough for their expenses (I1) significantly leads to positive impact on comfortable in workplace (E1).
- (4) Respondent's argument that salary from this company higher compared others company (I5) significantly leads to positive impact on respondent's skill necessary for handling roll forming equipment (W5).

(5) Strong positive significant between respondent's comments about company not aware about beltline moulding quality improvement (Q1) with quality of beltline moulding for local automotive lowers compared for foreign automotive (Q4).

6. Conclusions

Having identified the aforementioned experts view towards roll forming process in overall perspective, it is hoped that this study could assist us to explain to some extent how the company increase product quality and able to reach their full potential. The results of the study indicate that the main difficulties factors to find consistency parameter setting from the raw material failure. In an analysis of the most critical parameters for control the die to find the best finishing on the roll forming process. Meanwhile, the greatest contributors to the finishing in beltline moulding process who undertook the data collection are PVC. Besides that operator's training addressing that suggestions very important for increase product quality. This information suggests that owner and manager of this company need to further and better equip themselves through various programmes such as training and skill enhancement. By doing so, the owner and manager would be able to capture the best training programme that can help them focus on quality product for beltline moulding, creating growth, reducing costs from product defect and increasing profits from reducing time setting.

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Table 1. Nonparametric Correlations Spearman's rho

		D1	D2	D3	D4	D6	D8	I1	I5
D2	Correlation Coefficient	-.555(*)							
	Sig. (2-tailed)	.039							
	N	14							
D3	Correlation Coefficient	.580(*)							
	Sig. (2-tailed)	.030							
	N	14							
D6	Correlation Coefficient	.704(**)	-.786(**)						
	Sig. (2-tailed)	.005	.001						
	N	14	14						
I3	Correlation Coefficient				.622(*)			.592(*)	
	Sig. (2-tailed)				.018			.026	
	N				14			14	
I4	Correlation							.656(*)	

	Coefficient							
	Sig. (2-tailed)						.011	
	N						14	
W1	Correlation Coefficient		-.596(*)			-.605(*)		
	Sig. (2-tailed)		.024			.022		
	N		14			14		
W3	Correlation Coefficient				.631(*)			.730(**)
	Sig. (2-tailed)				.016			.003
	N				14			14
W4	Correlation Coefficient	.534(*)		.597(*)		.570(*)		
	Sig. (2-tailed)	.049		.024		.033		
	N	14		14		14		
E1	Correlation Coefficient						.732(**)	
	Sig. (2-tailed)						.003	
	N						14	

		D2	D4	D5	D6	I1	I4
E2	Correlation Coefficient					.607(*)	
	Sig. (2-tailed)					.021	
	N					14	
E3	Correlation Coefficient						.706(**)
	Sig. (2-tailed)						.005
	N						14
Q3	Correlation Coefficient		-.705(**)	.559(*)	.731(**)		
	Sig. (2-tailed)		.005	.038	.003		
	N		14	14	14		
Q4	Correlation Coefficient	-.555(*)					
	Sig. (2-tailed)	.039					
	N	14					

		W1	W2	W3	E1	Q1	Q2
W2	Correlation Coefficient	.536(*)					
	Sig. (2-tailed)	.048					

	N	14					
W4	Correlation Coefficient		.567(*)	.571(*)			
	Sig. (2-tailed)		.035	.033			
	N		14	14			
E2	Correlation Coefficient				.599(*)		
	Sig. (2-tailed)				.024		
	N				14		
E4	Correlation Coefficient				.559(*)		
	Sig. (2-tailed)				.038		
	N				14		
Q2	Correlation Coefficient					.800(**)	
	Sig. (2-tailed)					.001	
	N					14	
Q4	Correlation Coefficient						-.534(*)
	Sig. (2-tailed)						.049
	N						14

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).