

Research Methodology of a Research in Health, Safety and Welfare

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Abstract: - This research methodology is a part of my Ph.D. research thesis. The topic of the research was “study of HR practices related to Health, Safety and Welfare in the automobile industry situated in the Pimpri-Chinchwad industrial area, Pune, Maharashtra”. This chapter will be useful for the scholars preparing for Ph. D. in management science. This part contains research motivation, rationale behind selection of OEMs, Problem statement and Rationale and Significance of the Study. Further it focuses on objectives, hypothesis, limitations and research design. The research design explains in detail Unit of analysis, results of Pilot Survey and modifications in questionnaire, dependent and independent variables used, measurement scale used for response, Likert scale and A Review of Measurement Scales Used in Previous Researches. Validity, Reliability and Practicability, primary and secondary sources of data, determination of sample size, Basis of Stratification, Justification for Purposive Sampling, ways of data collection and their advantages and disadvantages are elaborated in detail. At the end it takes review of data Analysis and justifies statistical tools applied for hypothesis testing.

I. RESEARCH MOTIVATION

Researcher has worked in construction industry during 1987-2008. “It is a labour- intensive and second largest employer after agriculture in India, contributing about 12% in national GDP.”¹ The construction workers are one of the most vulnerable segments of unorganized labour exposed to wide variety of OHS hazards having the rate of fatal accidents is 4-5 times higher than that of the manufacturing sector.² Researcher has experienced number of violations on construction sites. Issues associated with safety are so wide that it makes confusion what measures should be taken into consideration for study. A study found significant difference in the safety climate of different organizations.³ “Government of India also concurred that construction industry has been witnessing decline in quality and safety aspect during past one/two decades. Underreporting of employed labourers (20% of the actual), highly unorganized nature of employment, inability of workers to respond government initiatives and the most no special division for enforcement of Acts are some responsible weaknesses”.⁴ Hence after voluntary retirement the researcher had decided to take up research in organized industry in OHS area. Another motivating factor is the researcher has been living in the PCIA since 1995 to till date. Similarly, OHS function is least studied, thought and described in the books of HRM. However, recently OHS has come into vogue because of upward trend in occupational

injuries & illness, costs associated with it and effect of globalization.

II. RATIONALE BEHIND SELECTION OF OEMS

According to types of enterprises as defined by Government of India Notification No. 1152 dated September 30, 2006, Large scale -54, Medium Scale-621 and Small Scale-5520 enterprises were registered in Pimpri Chinchwad Industrial area (PCIA).⁵

However, 65% of these are automobile companies; hence automobile sector has selected for study. Amongst automobile companies the original equipment manufacturers (OEMs) are selected for survey. The reasons are:

- i) Small scale companies employing less than 10 workers with power do not come under purview of the Factory Act.
- ii) The micro level study is not possible due to limited employees in departments. If there are less than 10 employees working in a shop it should be deleted from individual sample to uphold principle of anonymity.⁶
- iii) The problems of productivity, profitability and efficiency are key issues before the medium scale companies which do not allow them to look after HSW provisions. In a study by Afshin M. 2004 the problems in the proprietary, partnership and private limited companies were similar.⁷
- iv) The private sector is guilty of negligence on the safety point of view. In a research of small scale industries it is observed that, 65% companies do not have even elementary safety measures. In the unorganized sector many benefits and statutory welfare are ignored.⁸ The researcher also has interviewed the President, Pimpri-Chinchwad Small Industries Association Chinchwad and realized that the problems of small and medium scale industries are as analogous to above; where implementation of HSW at the workplace is less important issue.
- v) The unorganized workforce cannot express their rights or communicate anything which they think might lower their image in the eyes of management. This is on account of job security, confidentiality and direct relationship with owner(s).⁹

A news from Maharashtra Times, Pune (12th March 2012)¹⁰ indicates “Medium and small scale companies disregard the implementation of safety related provisions that is mainly because of scarce capital, lowering cost of operation and profitability which eventually result into higher rate of injuries. First –aid –box is not more than a show piece. The job need lowers voice of workers. Many small and medium workshops in this area employ 20-40 workers but on the pay role only 10 are recorded. This creates problem in the implementation of Acts.” The news blamed management as well as workers for strict enforcement of Law.

Hence, it felt appropriate to conduct the study in the original equipment manufacturers (OEMs) i.e. Tata Motors, Force Motors, Bajaj, Mahindra Vehicles Limited and Premier automobile limited situated in Pimpri Chinchwad Industrial Area (PCIA). Also as per experts’ opinions, HSW (Health, Safety and Welfare) issues shall be studied in major companies. Thus study has conducted in the seven plants of these five companies representing ‘automobile sector’. As Bajaj Company has shifted its majority of operation at Chakan, 15km away from its previous plant is considered in the sample.

III. STATEMENT OF PROBLEM

Title of the research topic:

“A STUDY OF HR PRACTICES IN AUTOMOBILE INDUSTRY IN PIMPRI-CHINCHWAD INDUSTRIAL AREA PUNE WITH SPECIAL REFERENCE TO HEALTH, SAFETY WELFARE (FOR THE PERIOD 2004-2010)”

The nature of problems addressed in the present study relates to assessment of implementation level of the mitigation of hazards faced by workers in different automobile companies as well as in the various shops in the same company. These problems are multidimensional in nature just as they would be need-based and action- oriented. This study attempts to answer the following set of questions.

- i) To what extent employees are aware about the HSW information?
- ii) What is satisfaction level of employees about implementation of HSW provisions in their shop?
- iii) Whether this satisfaction level has roots in the demographic variables?
- iv) Whether Government machinery is efficient for monitoring the HSW situation in the company?
- v) Whether the satisfaction level can be improved by maneuvering determinants influencing on it? To what extent it is associated with accidents and injuries?
- vi) How the implementations of provisions form a basis for healthy job relationship?

IV. RATIONALE AND SIGNIFICANCE OF THE STUDY

The basic idea in making statutory provisions about HSW is to regulate, monitor and govern the working conditions of the workers, so that their well being and welfare not only add to the production and productivity levels but also determines, to a large extent, the work culture and the work environment, which ultimately lead to a superior level of workers’ satisfaction and gives them a better quality of life.

The present study relates to the assessment level of workers satisfaction which is supposed to result from the implementation of HR practices relating to HSW. This study has conducted within the confines of five Original Equipment Manufacturer’s Plants situated in and around Pimpri Chinchwad Industrial Area.

It must be pointed out that a study conducted in the automobile sector would lead to different inferences from a similar study conducted in the context of another product like cement, pharmaceuticals or even the IT sector. Even in case of automobile companies the study conducted at different points of time would lead to different inferences. It may be reasonable to suggest that all such studies conducted in India or abroad would be time specific and the space specific.

It appears necessary to emphasize that every such study will be unique and will have limited replicability components. Therefore, the uniqueness of the study will depend on the time span for which it is relevant and the industrial product it involves.

It has to be appreciated that the implementation of HSW provisions would involve cost and at the same time would lead to enhancement in the level of workers satisfaction, but its inverse correlation with accident and injury rate cannot be denied.

In every factory the final output is an outcome of several production processes which are conducted in several shops; the activities relating to each one of these shops would obviously be different and quite naturally the HSW norms required to be implemented would also be different. The assessment of workers satisfaction level in each one of these shops would have to be independently made at the “micro shop” level and will be quite distant from the “macro plant” level. Many previous studies (*Zambare Swati M., 1983, Gongera Enock George, 1999, Kumbhar P.B., 2000, Cheyne et al.2001, W.K. Law et.al., 2006, A. Sabarirajan et al. 2010, Cristina De Souza et al., 2011*) have assessed satisfaction level relating to HSW at macro level which may give general and different picture from micro level. **This study focuses satisfaction as well as implementation level related to HSW at micro level; hence, in this regard it is unique.**

Also, the said study by Kumbhar P. B., 2000, in Pune region is based on 3-Point rating scale: Low satisfaction, medium satisfaction and very high satisfaction. Limited options on the rating scale might have produced exaggerated results from than that of five-point rating scale.

For measuring effectiveness of Governments, previous researches (Deosthali Hemant, 1993, Kaila H. L., 2011) were based on dichotomous questions where the options were limited. In this research we have procured degree of respondent's agreement on 5-point scale which would give more insights into the situation.

V. OBJECTIVES OF THE STUDY

- i) To find out workers' awareness about HSW activities and provisions in the sample companies.
- ii) To study, assess and quantify the satisfaction level in various shops of the plants of selected automobile companies with regard to HSW.
- iii) To evaluate implementation of HR practices related to HSW at each shop.
- iv) To identify the effect of demographic variables on the workers' satisfaction relating to HSW.
- v) To evaluate efficiency of the Government Machinery in monitoring HSW provisions in the sample companies from macro as well as micro angles and to know lacunas in the functioning with specific reference to Pune district.
- vi) To establish the relationship among the employees' satisfaction level, implementation of HR practices related to HSW and the injuries/accidents.
- vii) To see how the implementation of HSW provisions contribute in the establishing shop level healthy relationship.

VI. HYPOTHESES

H1: The most of the workers in automobile companies under study are significantly aware about the provisions of Health, Safety and Welfare.

H2: The supervisory mechanism of the Government is inefficient to monitor various provisions of the Factories Act relating to Health, Safety and Welfare.

H3: Workers' satisfaction related to Health, Safety and Welfare is independent on the demographic variables: age, marital status, number of family members, education level, work-experience, nature of job and income level.

H4a: The shop specific satisfaction level of employees depends upon implementation of HR practices relating to HSW.

H4b: Lower level of satisfaction relating to HSW results into higher accidents/injuries.

H4c: Lower level of implementation of HR practices relating to HSW results into higher accidents/injuries.

H5: Higher level of implementation of provisions related to Health, Safety and Welfare would lead to form a basis for healthy job relationship.

VII. LIMITATIONS OF THE PRESENT STUDY

7.1 Effect of Extraneous Factors

- i) Information collected for the purpose of this study is on a point of time and in different circumstances which may have impact on the response. Contacting operators at home without permission of their company, at workplace with permission of superiors and with favour of trade union representative (Company-E) may have different impact on responses.
- ii) Survey questions are structured in general which are representative of the various provisions made under Sections of F.A. The number of questions is kept minimum but sufficient to avoid long length of questionnaire and improve response rate. However, many Sections cover so diversified aspect that no single or two questions can be framed to be representative of the Section. Hence, the response to the question is regarded to the whole Section.
- iii) The selection of operators in a shop was highly dependent on the supervisors and managers. It might be possible that they had selected respondents' favourable to them which might lead to increase in the level of satisfaction.
- iv) The situation of union was different in the different companies: Company A, B and E had a single union, Company C had multiple unions and Company D had no union.

7.2 Effect of Respondents Tendency

Respondents have tendencies to make three types of errors in rating scale: 1) leniency, 2) central tendency and 3) halo effect.¹¹ In the design of questionnaire to reduce effect of leniency the asymmetric scale has constructed assuming 'satisfactory' response at the centre. To counteract central tendency error the difference between ends and before it are easily identifiable. Strength of descriptive adjectives has adjusted to differentiate end point and in-between. Halo effect is a systematic bias and pervasive error, difficult to avoid. We have made a separate section for each trait to neutralize its effect. Also a break has given in the questionnaire to eliminate response set bias by asking ranking, open ended and dichotomous questions intermittently.

VIII. RESEARCH DESIGN

8.1 Unit of analysis

Safety is everybody's job. Various researches (Jeremy Stank and HSE) mention that H&S shall be measured at shop floor, line management and top management level. Accordingly we have tried to predict implementation level of HSW provisions taking into consideration responses from following stakeholders.

- i) Operators - Who are working on the machinery and assembly lines

- ii) Line management consisting of supervisors/cell leaders/ shop floor managers- who are directly related with working conditions.
- iii) Managers- HR managers, Production managers, Medical officers, Safety officers, and Welfare officers.
- iv) Trade Union- Members
- v) Government Machinery- Directorates of Industrial Health and Safety (DISH).

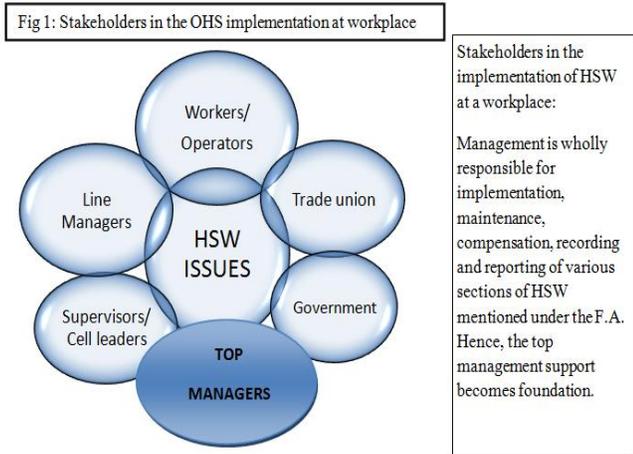


Table 1: Details of Pilot Survey

Minimum elapsed time	10 Min	Response rate	76 %
Maximum elapsed time	40 Min	Completely answered questionnaire	45
Average time	17.2	Difficulties in understanding	9
Average time excluding 10 Min*	20.4	Incomplete questionnaire	2
Total questionnaires distributed	75	Deleted	1
Questionnaires received	57	* These respondents had read questionnaire before answering	

The final questionnaire was modified by incorporating following changes.

1. As no female was working in the shop floor in the sample companies hence the question of gender has deleted.
2. To save Space drop down boxes containing a range answer options has used in the questionnaire.¹²
3. Five point rating scale has adopted instead of four point scale.
4. Changes have been made in the drafting of question to make it vernacular.
5. Instead of numbers on rating scale, descriptions are given in the drop down boxes.

Structure of final questionnaire for measuring implementation level of HSW provisions at workplace/shop/block level was as below. This questionnaire was common for operators, supervisors and line managers.

8.2 Pilot Survey

A pilot survey was administered on operators in the sample companies between the period 2nd and 15th May 2011. 9 respondents faced difficulties to answer question questions 4a, 5a and 6a which were designed according to numerical scale without descriptive, faced difficulty in answering. The results of survey have presented in the following table.

Table 2 : Structure of the final questionnaire

Section- Title	Open ended	Scaled responses	Multiple choice	Dichotomous	Ranking	Total	Percentage
A- Preliminary Information	8	0	3	0	0	11	12%
B- Awareness	0	9	3	0	0	12	13%
C-Health	3	12	0	0	3	18	20%
D-Safety	4	25	0	3	3	35	38%
E-Welfare	3	8	1	0	3	15	16%
Total	18	54	7	3	9	91	100%

Question wording: The response rate is inversely proportional to the length of the questionnaire. Considering education

level, reading habit of respondents especially operators a special attention had given to minimize the number of words.

Table 3: Question Wording

Common part: number of words	3	4	5	6	8	10	12	15	
Frequency	4	5	3	4	3	2	1	1	1. 50 (60%) questions out of 82 have 4 or less words. 2. Total words in questionnaire=541 3. Researcher’s appeal note = 182 words 4. Instructions to respondents = 55
Question wording	1	2	3	4	5	6	7		

Frequency	16	17	7	10	6	3	3	words 5. Total words = 778 words
Question wording	8	9	10	12	13	15	18	
Frequency	4	4	3	3	4	1	1	

Questionnaire –II was additional questionnaire specifically designed for supervisors and managers, wherein policy related questions were included. 28 questions were asked to get their responses on 5-point Likert scale from ‘strongly disagree’ to ‘strongly agree’.

8.3 Dependent And Independent Variables

- a. **Dependent variable (Qualitative):** - The dependent variables are based on the provisions of Health (chapter IV, section 11 to 20), Safety (chapter IV, section 21 to 41) and Welfare (chapter IV, section 42 to 49) of the Factory Act 1948. The questions are framed considering the purpose of the concerned section to avoid complexity and length of questionnaire.
- b. **Quantitative measures:** Weighted Frequency Severity Incident (FSI) calculated from FSI of three years indicating accident/injury rate.
- c. **Independent variables:** Communication, Compliance, Regulatory framework, Involvement, Supply of necessary asset and Government intervention are considered as independent variables influencing on the satisfaction level of employees.

8.4 Measurement Scale

The satisfaction on 5-point Likert scale was taken assuming that the ‘satisfactory’ response lies at the central position considering these well established companies of India. With the balanced scale, the distribution of responses likely to be skewed to the positive side hence to bring it at centre unbalanced scale felt appropriate.¹³ According to the survey by *Infosurv (2010)*, use of 5 point scale preferred by 71% respondents as against 12% preferred 6-point scale. Following are limitations raised of other scales.¹⁴

4 and 6 point scale can’t record neutral response, which is supposed a legitimate response. Naresh K. M. found that Five-point rating scale produced better results than 10 point rating scale in terms of the data characteristics as there were very little differences in the variation about the mean, skewness or kurtosis.¹⁵

Minnesota satisfaction questionnaire and Job description index are the most commonly used techniques for measuring job satisfaction. The Minnesota Satisfaction Questionnaire is a paper-pencil type of a questionnaire usually takes between 15-20 minutes for completion. It has two versions as mentioned below.¹⁶

Table 4: Satisfaction Scale Versions and Adopted Scale				
1967 Version		1977 Version		Our Questionnaire
_ Not satisfied, _ Somewhat satisfied, _ Satisfied, _ Very satisfied and _ Extremely satisfied.		_ Very satisfied, _ Satisfied, _ Neither satisfied nor dissatisfied, _ Dissatisfied and _ Very dissatisfied.		_ Highly dissatisfied _ Less satisfied _ Satisfied _ More satisfied _ Completely satisfied
Response scale rating values and nomenclature used				
1	2	3	4	5
Highly dissatisfied	Less satisfied	Satisfied	More satisfied	Completely satisfied
Not at all	Rarely	Some times	Many times	Every times
Not at all known	Slightly known	Somewhat known	Moderately known	Substantially known
Strongly Disagree	Slightly Disagree	Uncertain	Slightly Agree	Strongly Agree

8.5 LIKERT –TYPE SCALE

The use of quantifiable scales when seeking information about non-mathematical statements such as Likert scale has been accepted in behavioural and attitudinal research including employee satisfaction. Treating ordinal scales as Likert scales has long been controversial however it has

become common practice to assume that Likert-type categories constitute interval-level measurement. The appropriateness of assumption should be addressed in research design.¹⁷ Brown J. D. states “Several researchers for instance, Baggaley & Hull, 1983; Allen and Seaman 1997; Maurer & Pierce, 1998; and Vickers, 1999 have shown that *Likert scales*

can indeed be analyzed effectively as interval scales. Likert scales as interval data if the scale item has at least five or preferably seven categories. Likert items are ordinal but the total scores are always treated as interval data; provided the scales pass the Cronbach’s alpha or the Kappa test of inter-correlation and validity”.¹⁸ Likert in his researches combined the responses from series of questions and analyzed composite score instead of individual question score after deletion of neutral responses. Likert scale composite score should be analyzed at interval scale.¹⁹ “The data are typically treated as interval scale. When using this approach to determine the total score, it is important to use a consistent scoring procedure so that a high (or low) score consistently reflects a favorable response.”²⁰

Similar opinion has offered by Chester H. MecCall. The choice of the midpoint may result from ignorance, uncooperativeness, reading difficulty, reluctance to answer or inapplicability. Hence, selection of midpoint seems innocuous and which may lead to raise or lower the average response erroneously which eventually affect on decision making process.²¹

To treat it as merely ordinal would lose information. Where equal spacing of response levels is clearly indicated, the argument for treating it as interval-level data is even stronger. **If guaranteed by the Central Limit Theorem that ordinary averages of the Likert scale data behave normally, parametric analysis maybe performed.** It is also recommended that the scale shall reflect increasing levels of an attitude or trait. The verbal description should be converted into interval of means of equal difference (0.80 in case of 5-point scale) in order to give interpretations for the weighted mean.²²

Table 5: Likert scale descriptors and range

Likert Scale	Description-1	Description-2	Interval
1	Highly Dissatisfied	Never	1.00 – 1.80
2	Less Satisfied	Rare	1.80-2.60
3	Satisfied	Sometimes	2.60-3.40
4	More Satisfied	Often	3.40-4.20
5	Completely Satisfied	Always	4.20-5.00

Cristopher A. Janicak recommended using Likert scale for measurement of safety performance.²³ However, the major disadvantage of the Likert scale is that it takes longer time to complete than other itemized rating scales. Respondents have to read the entire statement rather than a short phrase. Hence, to achieve high response-rate we have avoided wordy questions.

Douglas W. Hubbard mentioned decomposing the situation under consideration and selecting proper variable (s) which is (are) indicative of the whole may be to some extent erroneous. Many times it is not necessary to have great precision in measurement but it should be sufficient to justify

the say. He also recommended wordy questions are more likely to confuse hence shall be avoided or reduced.²⁴ In our questionnaire design care has taken to keep question simple and precise and tried to break tendency of response set bias by putting open ended and dichotomous questions intermittently.

8.6 A Review of Measurement Scales Used In Previous Researches

Likert Scale and Dichotomous measurement have adopted by many researchers as a measurement instrument for assessing working condition and Health and Safety related issues at workplace. A short account of these researches has presented herewith on the basis of Chapter 3: Review of Literature.

Table 6 : A Review of Measurement Scales Used in Previous Researches

Researcher	Attribute	Sample size	Scale used
Kumbhar P.B., 2000, Ph.D. Thesis	Working conditions , various provisions in the Factories Act	500	3-Point rating scale: Low satisfaction, Medium satisfaction, Very high satisfaction
Nor Azimahchew Abdullah et al.	OHS management in 9 key areas – 81 items	418	5-Point Likert scale
Cheyne A. Oliver, J.M. Thomas Cox, 2002	Attitude of employees towards safety	N= 708, organizations -2	Attitude scale
Dawal S.Zaviah & Taha Zahari,2006	The effect of environmental factors on job satisfaction	2 automotive companies N=170 (male)	Very uncomfortable to very comfortable 5-point scale
European Foundation, 2007 and 2012	Living and working conditions	15 European countries , N>20000	4-Point Likert type scale, Not at all satisfied to Very satisfied without neutral point.
Abuduani Wubuli, 2009	Working conditions	15 organizations N= 108	5-Point Likert scale, Very happy---Very unhappy
K.K.Singh, Anita Pathak, 2009	Awareness of labour welfare	N= 50	Dichotomous measurement
A Sabarirajan, T. Maharajan, B. Arun, 2010	Welfare and safety	N=250	5-Point Likert scale, from Highly satisfied to highly dissatisfied
Buck Consultants Survey, 2011	Global survey on health promotion and workplace wellness	47 countries, 1248 organizations, N=13 Million	Dichotomous measurement

8.7 Validity, Reliability and Practicability

In order to have confidence in the results of a study, one must assure that the questionnaire consistently measure what it purports to measure. There are three major criteria for evaluating the measurement tool: Validity, Reliability and Practicality. Validity refers to extent to which a test measures that actually one wish to measure. According to widely accepted classifications in research area there are three major forms of validity, which we have taken into consideration.

a) *Content validity*

As we have intended to undertake study of implementation level of statutory HSW provision, we have framed an indicative question based on the relevant section. Wherever it found necessary, two questions have asked. Also, it was critically reviewed by five academicians having Ph.D. and five HR/Safety managers as per instructions of guide and appropriate corrections were made accordingly.

b) *Criterion-related validity*

The criteria measures have judged in terms of four basic qualities i.e. relevance, freedom from bias, reproducibility and availability of information with respondent.

c) *Construct validity*

Judgments of experts and theoretical concepts supported the goodness of items to measure dependent variable.

Face validity is basically subjective; questionnaire layout, balloon instructions, shaded columns exhibits professional touch.

Reliability has checked by using Cronbatch alpha and Karl Pearson's coefficient of correlation between the means of the sample and randomly (referring random numbers from 'Business Research Methods')²⁵ selected sub-samples at shop level. Reliability has also checked by Cronbach's alpha. Its higher value is an indication of internal consistency, homogeneity or uni-dimensionality. Internal consistency is interrelatedness of a sample of test items; whereas, homogeneity refers to whether items in questionnaire measure a single latent trait or construct. "Internal consistency is necessary but not sufficient condition for measuring homogeneity in a sample of test items. Hence, it cannot be interpreted as an index for internal consistency of a test. The accepted value of Cronbach's alpha is 0.7 to 0.95" (Michael J. Miller, 2003²⁶, Mohsen T et al. 2011²⁷). Regarding reliability necessary sample size for coefficient of alpha is commonly suggested as 200, 300 or 500. In some cases the sample size of 100 will be adequate.²⁸ However, alpha can be high in spite of low inter-item correlation and multidimensionality as number of items increased. Average inter-item correlation of 0.30 or better are exemplary.²⁹

Practicality consists of three elements namely: economy, convenience and interpretability. As mentioned earlier, the reason behind adoption of face to face interview with questionnaire method is to improve response rate. Clear, complete and several times instructions have given to make questionnaire convenient to read and respond. Interpretability has maintained by correcting some questions according to pilot survey results.

A separate questionnaire had drafted for measurement of contributory factors for supervisors, line-managers and top management.

8.8 Sources of Data

A) Primary data

Primary data have collected through field work by the researcher. A separate questionnaire had designed to collect the required data from the stakeholders namely:

- a) Workers
- b) Trade Unions
- c) Management – Supervisors and Managers and
- d) Government.

Personal interview with Questionnaire method has used for data collection to exploit following benefits:

- i. It gives high response
- ii. It is more flexible method of obtaining data
- iii. Supervision and control is possible which ensures more accuracy
- iv. References of other respondents can be obtained.

Though it took more time it was necessary from the viewpoint of structure of the questionnaire which demands more information. Also, the researcher has been staying in the area of research, it became possible. The data from the operators have collected during the period 1st July to 30th November 2011.

B) Secondary data

Secondary data have collected on the basis of the published literature from various sources listed as below.

- i) Annual reports of the Automobile Companies e.g. Premier Ltd., Tata Motors, Mahindra Vehicles and Manufacturing Ltd., Force Motors and Bajaj Auto.
- ii) Relevant section of the Factory Act 1948, Maharashtra Factory Rules 1966 etc.
- iii) Periodicals, research journals, books, newspapers, articles etc.
- iv) The reports of the Government departments.
- v) Data available on web sites.
- vi) Committee reports
- vii) Ph.D. theses and M. Phil. Projects on the concerned topics.

8.9 Sample Size

The required sample size depends upon number of issues such as the desired power of relationship, alpha level, number of predictors and expected effect sizes. The simplest rules of thumb are $n \geq 50 + 8m$ (where 'm' is the number of independent variables) for testing multiple correlation and $n \geq 104 + m$ for testing individual predictors (Green S.B., 1991³⁰ and Comrey and Lee, 1992³¹). Accordingly, our sample size is sufficient as per requirement.

Table 7: Calculation of Sample Size

Criteria	50+8m	104+m
n >=	50+8x28 = 274	104+28 =132
n taken	1331	1331

Formula	Values based on pilot survey	n
$n = \left[\frac{z \cdot \sigma p}{(\mu p - \bar{x})} \right]^2$	$\sigma p = 0.832$ and $\bar{x} = 2.95$ $\mu p = 3$	1064
$n = \frac{3.8416 \cdot N \cdot \sigma p^2}{(N - 1) \cdot e^2 + 3.8416 \cdot \sigma p^2}$	$N = 35000, e = 0.05,$ $z^2 = (1.96)^2 = 3.8416$ $\alpha = 95\%$	1032
$n = \frac{p \cdot q}{\sigma prop^2}$	Optimum proportion has considered $p = q = 0.5,$ $\sigma prop = 0.05 / 1.96 = 0.0255,$ $\alpha = 95\%$	385

We have followed the rule stated by:

1. Donald Cooper and Pamela S,³²

“In a given stratum take a larger sample if stratum is larger than other strata; the stratum is more variable internally; and sampling is cheaper in the stratum” and “If the calculated sample size exceeds 5% of the population; sample size may be reduced without sacrificing precision”

2. Gupta S.P.,³³

“There are diverse opinions among researchers about sample size. However, 5% to 10% of the universe size has mentioned by many researchers”

In the sample companies, there are 20,341 operators. The sample size taken for this research work is 1331; which is 6.5% of the population. The samples of a company have taken according to support provided by the corresponding company and available time.

TABLE 8: COMPANY WISE SAMPLE SIZE

Company Names	Company code	Operators	Sample size	Percentage	Supervisors	Managers
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Premier Ltd.	A	1490	150	10.1%	31	22
Tata Motors	B	13261	793	6.0%	102	75
Mahindra	C	3250	169	5.2%	34	29
Force	D	1350	128	9.5%	39	30
Bajaj	E	990	91	9.2%	17	15
	Total	20341	1331	Av. 6.54%	223	171

TABLE 9: SHOP-WISE SAMPLE SIZE

Code	Shop Name	SC	Total op.	SSop	Percent	SSsup	SSmgr
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A	MTD	A 1	300	30	10.0%	10	6
	Engg/Innercon	A 2	615	60	9.8%	8	6
	LVD	A 3	270	30	11.1%	8	5
	Machine Shop	A 4	305	30	9.8%	5	5
B (1)	Block-B	B 1	560	56	10.0%	10	8
	Block-C	B 2	1225	81	6.6%	11	7
	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Block-D	B 3	1512	98	6.5%	15	8
	Block-E	B 4	993	78	7.9%	10	8
	Block-H	B 5	1610	55	3.4%	9	7
	Block-J	B 6	2504	182	7.3%	12	10
	ERC	B 7	2315	54	2.3%	8	6
	Block-K	B 8	1450	92	6.3%	10	8
	APD/RATP	B 9	298	29	9.7%	8	6

	Foundry	B 10	794	68	8.6%	9	7
C	TCF	C 1	700	35	5.0%	7	6
	Press Shop	C 2	900	47	5.2%	9	7
	B-I-W	C 3	800	33	4.1%	7	6
	Engine	C 4	450	31	6.9%	6	5
	Paint Shop	C 5	400	23	5.8%	5	5
D	Press Shop	D 1	100	10	10.0%	5	5
	Foundry	D 2	50	10	20.0%	5	5
	Ta Body Shop	D 3	125	14	11.2%	7	5
	Engine Shop	D 4	300	30	10.0%	7	5
	R&D & Tool	D 5	100	11	11.0%	7	5
	Transmission	D 6	675	53	7.9%	8	5
E	Press Shop	E 1	150	16	10.7%	5	5
	Engine Shop	E 2	300	27	9.0%	5	5
	Vehicle Assy	E 3	540	48	8.9%	7	5
Total		28	20341	1331		223	171
SC- Shop Code, Op - Operator, SS - sample Size, Sup – Supervisor, Mgr – Manager							

8.10 Basis of Stratification

Stratified purposive sampling method is used for the survey. This is because of the following reasons:³⁴

The classification of strata is based on various shops in the company. According to the inherent characteristics of the work carried out in various shops, the working condition formed in each case may be different; which eventually affect on the intensity of the requirement of the operators. The micro level study covers the shop level satisfaction; while the macro aspect is organizational level and industry level includes all sample companies take together. The reasons behind adoption of stratified sampling are:

- To increase a sample's statistical efficiency
- To provide adequate data for analyzing the various sub populations and
- To enable different research methods and procedures to be used in different strata.

8.11 Justification for Purposive Sampling

Probability sampling is theoretically superior but practically difficult in application. Even carefully selected random sampling respondent may respond carelessly. Hence, "self selection is more important than random selection". Non probability sampling procedures also satisfactorily meet the sampling objectives when getting true cross-section of the population is not objective of the research. Probability sampling calls for more planning, strong organizational

support, repeated call backs to contact selected sample member. These activities are expensive, time consuming and many times do not give guarantee of acceptable response. "Carefully controlled non probability sampling often seems to give acceptable results." Hence purposive sampling by judgment and self selection by the respondent were considered during sampling process.³⁵ The same opinions are given by Donald Cooper and Schindler Pamela.³⁶

In the sample selection the first aim was 'Most of the characteristics of interest should be present in the respondent, so that most of questions would be answered authentically.' Secondly, the sample selection was from wide spectrum. We have taken due care to include respondents from various age groups as other demographic characteristics depend upon it.

8.12 Data Collection

The survey was made successful with the help of company management as well as union leaders. The operators were explained that the survey is totally unconnected with either management or union leaders. The survey was conducted in the conference room attached with every block or shop of the company in absence of any managerial grade person. In some cases it was conducted at respondents home or on the occasion of group meeting set individually. During survey the care has taken to achieve unbiased response. Following figure shows the different ways adopted in data collection and subsequent table 4.10 explains advantages and disadvantages associated with each of them.

Fig 2: Ways of Data Collection

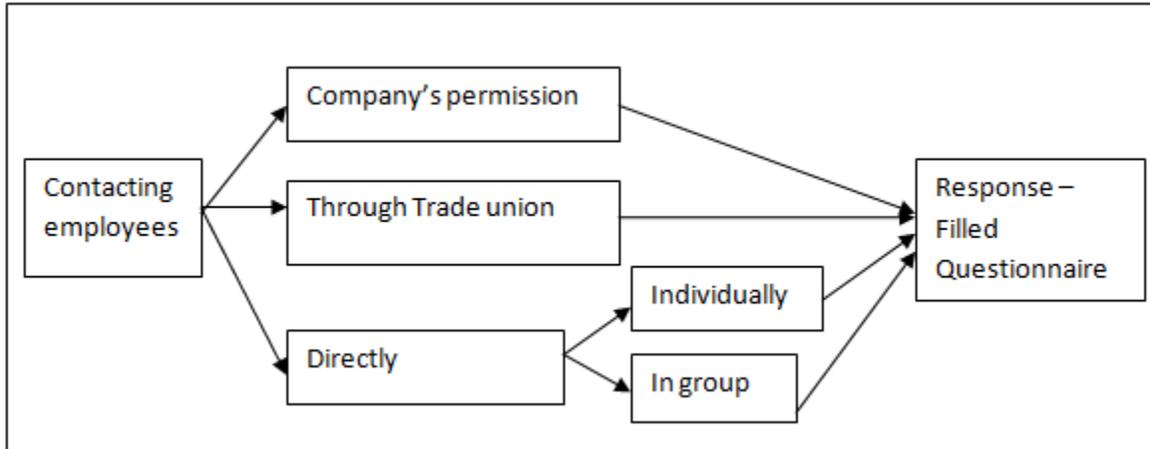


Table 10: Advantages and Disadvantages of Different Ways of Data Collection	
Advantages	Disadvantages
A) Company Permission	
1.Ease in approaching employees 2.Employees feel free to express 3.Supported by company hence can participate more actively 4.References of other employees can be taken	1.Role of manager/supervisor in employee selection 2.Influence of management on response 3.Less time due to loss of productive hours 4.Requires separate cabin /space 5.Company may not allow to contact employees during the time of high production, crisis or agreement 5.Can be conducted during the duty hours only
Advantages	Disadvantages
B) Through Trade Union	
1.Employees are supported by union hence feel free 2.Usually members are more expressive hence can get additional information 3.No loss of productive hours	1.Selection of favorable members only 2.Influence of union philosophy on response 3.Influence of union leader's speech on rating 4.Diverse opinion in case of multiple union
Advantages	Disadvantages
C) Directly	
1.Can be conducted at surveyor's own time 2. A pre-appointment with briefing and reference may improve response 3. Management or Trade union's support is not necessary 4. Sufficient time can be taken 5. Personnel contacts can be developed 6. Easy in case of unmarried employees 7. More information can be obtained	1. Employees may not feel free in response 2. Time consuming as employees have to contact at home or wait for their gathering 3. It is based on references and hence conveyance sampling 4. Possible for local researcher or surveyor. 5. Employees assembled for other purpose may undermine significance of the research. 6. It is expensive method 7. Depends upon communication skill

8.13 Data Analysis

The primary data collected at a point of time are the outcome of the implementation level of the HR practices relating to HSW maneuvered by the management. The collected data are analyzed by using various statistical techniques such as – Measures of central tendency, Standard

deviation, and Coefficient of correlation as per need of the study. The results are presented using graphs, Histograms, Pie diagrams and tables. All data analysis has carried out by using 'data analysis' software available in excel. Normality which is an essential requirement for use of these tests has been checked by using:

1. Empirical Rule 2. Chybyshv's Theorem and 3. Skewness and Kurtosis

Table 11: Statistical Technique Applied for Hypothesis Testing

Hypothesis	Statistical Technique Applied
H1	One tailed t-test
H2	One tailed t-test
H3	Correlation and Two sample t-test
H4	Multivariate Regression Analysis and correlation
H5	Theoretical Explanation and previous findings

Explanation of Statistical Tools Applied

- i) Methods of t-test are applicable for small samples as well as large samples, though the reverse is not true! In our case minimum sample size at shop level is 10; whereas, maximum is 182. Samples above 30 are 16 and 12 samples are equal to or less than 30.
- ii) Our calculation work confirms that the population can be assumed to be normal. In case of markedly skew i.e. U or J shaped this method cannot be applied with confidence.
- iii) The reliability check (Cronbatch alpha and Correlation) assures that Likert scores can be suitably assumed to be interval scale.
- iv) Hence, t-test, correlation test and regression analysis have applied.

Hypothesis 1: The most of the workers in automobile companies under study are significantly aware about the provisions of Health, Safety and Welfare.

This hypothesis is based on assumption that the awareness level of workers about provisions of HSW is significantly more than the central point "3". Here theoretically following situation may occur:

Table 12: Interpretation of t-test (For awareness)

No	Situation	t-calculated value	p-value	Conclusion
1	Awl = 3	+ve or - ve but numerically within t-critical	>0.05	Insignificant
2	Awl > 3	+ve and numerically more than t-critical	< 0.05	Significantly more
3	Awl < 3	-ve and numerically more than t-critical	< 0.05	Significantly less

Hypothesis 2: The supervisory mechanism of the Government is inefficient to monitor various provisions of the Factories Act relating to Health, Safety and Welfare.

The same theory is applicable. Here following situation may occur:

Table 13: Interpretation of t-test (For Government efficiency)

No	Situation	t-calculated value	p-value	Conclusion
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1	Govti = 3	+ve or - ve but numerically within t-critical	>0.05	Insignificant
2	Govti < 3	-ve and numerically more than t-critical	< 0.05	Significantly Less
3	Govti > 3	+ve and numerically more than t-critical	< 0.05	Significantly More

Hypothesis 3: Workers' satisfaction related to Health, Safety and Welfare is independent on the demographic variables: age, marital status, number of family members, education level, work-experience, nature of job and income level.

This is a complex hypothesis involving multiple variables. Hence, it feels appropriate to test this challenging hypothesis using correlation analysis and t-test as explained below.

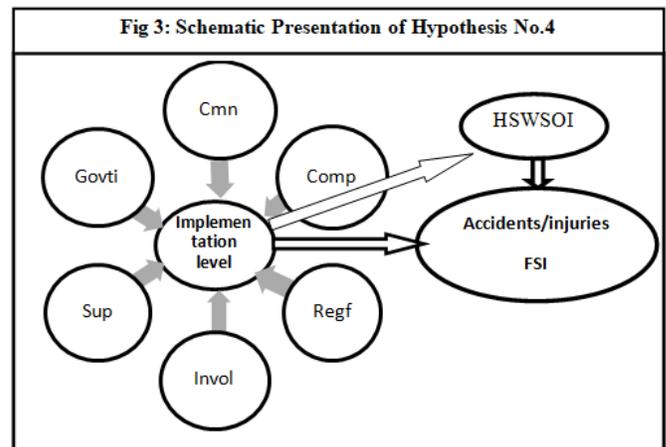
- i) Find out Karl Pearson Coefficient of Correlation (denotation "r") for each of the relationship of the demographic variable with HSWSI at shop level.
- ii) Find out the critical values of "r" for the (df=N-2, N= sample Size) and $\alpha=0.05$
- iii) Make conclusion about significance of correlation as usual
- iv) In case of categories i.e. marital status and nature of the job apply two-sample t-test and find out "t-cal" and p-values as usual.
- v) For more insights into data use percentages of number of cases and population belonging to significant and insignificant categories.

Hypothesis No.4

H4a: The shop specific satisfaction level of employees depends upon implementation of HR practices relating to HSW.

H4b: Lower level of satisfaction relating to HSW results into higher accidents/injuries.

H4c: Lower level of implementation of HR practices relating to HSW results into higher accidents/injuries.



Independent Variables: The components of Implementation level of HR practices: Communication (Cmn), Compliance (Comp), Regulatory Framework (Regf), Involvement (Invol), Supply of assets relating to HSW (Sup) and Government intervention (Govti).

The dependent variable (Qualitative): Level of satisfaction about HSW.

The dependent variable (Quantitative): Accident/injury rate or FSI (Frequency Severity Incidence)

In case of a), there are six independent variables and one dependent variable. As all data are assumed to be quantitative and hence metric, the general linear model followed in multiple regressions. The photo copy of reference (C.R.Kothari, "Research Methodology, Methods & Techniques" New Age International Publications, India, 2004, p. 317, fig 13.1³⁷) is appended in the Appendix-I. The necessary parameters have calculated before test to give justification of assumption of linearity and normality.

The general model with usual denotations is presented as:

$$Y' = A + B_1 X_1 + B_2 X_2 + B_3 X_3 + B_4 X_4 + B_5 X_5 + B_6 X_6$$

In our case,

$$HSWSOI = A + B_1 Cmn + B_2 Comp + B_3 Regf + B_4 Invol + B_5 Sup + B_6 Govti$$

Where B_i indicates regression coefficient and are weights assigned to each of the independent variable. A is Y axis intercept.

Other parameters "R²" and "t" have calculated to conclude about the weights or power of influence of the variables in determining level of satisfaction. Coefficient of correlation "r" has calculated to explain the data.

In case of b) and c) the usual correlation analysis has adopted to make conclusion.

Hypothesis 5: Higher level of implementation of provisions related to Health, Safety and Welfare would lead to form a basis for healthy job relationship.

This hypothesis has tested on the basis of theoretical construct, statutory perspective and research findings of previous hypotheses.

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