Analysis of Incentivised Remuneration Schemes in Construction Industries

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***Abstract*— This paper puts forward a framework for benchmarking appropriate remuneration schemes for optimum labour productivity in highly unique construction industries in modern engineering practice. Socio-economic motivational factors among the various stakeholders have been identified and analyzed in order to incorporate in overall decision making process. The research aims to develop an automated decision support system (DSS) forecasting the best possible configuration of remuneration schemes incorporating project specific variables. The imprecision and subjectiveness of the decision making process are modeled using fuzzy set theory and multi-criteria analysis. The overall framework is designed to facilitate the selection of appropriate linguistic variables in real decision situation and allow the decision makers to explore the interrelationship between criteria and alternatives in ranking the outcomes. Theoretical work has been done to extend Analytical Hierarchy Process (AHP) for decision makers expressing approximate preferences based on relative importance of two factors at a time.**

***Index Terms*— Multi-criteria decision analysis, AHP, fuzzy preference modeling, incentive program**

I. Introduction

THE motivation levels of employees has a direct influence on their individual output, and furthermore on the level of output of a team of employees. There are many factors that influence the level of motivation of employees. Throughout history employers have sought to find the most successful ways of motivating employees. Historically motivation was thought to be achieved by having punishments associated with non-performance, whereas today's thinking is more along the lines of rewarding success [1]. Incentive Programs are coordinated programs through which employees are rewarded based on many motivational factors as discussed further in this paper.

This research has been carried out focusing on the construction industry due mainly to the fact that there are a few if any incentive programs currently in place within Australia's construction industry. Traditionally in Australia, unions have focused their attention on encouraging distance between employer and employee relationships. Programs such as incentive programs aim at reducing this gap and encouraging workers to participate more actively in decision making processes surrounding their work. Incentive programs (IP) are being used in many industries to increase worker productivity in line with the organization's objectives. The construction industry is one such industry in which IP is not widely used. This paper has discovered that the opportunity exists for organizations, within the construction industry, to develop and implement IP as a successful means for increasing worker productivity and output [2],[5].

An in depth literature review has discovered a link between the offerings of incentives and increase in employee's work motivation leading to increased worker productivity and output. The review further determined the adaptable nature of incentive programs, thus suggesting the possibility for its implementation within the construction industry [5].

This research includes the survey of over 150 individual employees within various construction industries with regards to their attitude towards the implementation of incentive programs. Results indicated that 78% believed that the prospect of rewards would positively their work productivity. The research found a strong synergy between factors affecting worker output and way an Incentive Program could have a positive impact. The results were analyzed using a Multi-Criteria Decision Making Process originally documented by Saaty [3], known as Analytical Hierarchy Process (AHP). The process determined that an Incentive Program could increase worker output, within the construction industry, nearly two times more than not having such a program in place. The overall output of this research has significantly influenced the management approached in senior management levels that contributes in project success [4].

II. Motivation and Incetive Programs

A. Motivation

Motivation is the process whereby goal-directed activity is investigated and sustained. Motivation is considered as the driving force behind an employees attitude toward his/her work. The term "*motivation*" refers to the reasoning why an individual is prepared to put effort into achieving something. This definition provides a basis of this research in understanding and devising a holistic link in successful

This work was conducted as a pilot study in two separate undergraduate honors theses under author's supervision.

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project delivery [6]. Therefore motivation is defined as the level of an employees drive to produce above and beyond his/her latent output [8].

B. Incentive Program

An incentive program is defined as a schedule of events that induces action or motivates effort. For the purpose of this study this definition will suffice as the definition for that part of an employee's work, which is above and beyond their latent level of work, based upon their current remuneration package. An incentive program will be a scheme that offers an employee a benefit in return for a higher level of output [8].

III. The Necessity of Customized Incentive Program

The natural question to be posed at this point would be: *If an organization aims at motivating their employees why implement incentive programs verses simply increasing the level of an employees pay?* This question needs to be answered in order to establish whether or not this investigation is valid. There is a large pool of literature that points to the fact that even if employers increased an employee's level of pay (base salary/wage) the increase in output may not be substantial.

In order to properly understand this phenomenon of why increasing an employee's salary will not result in a linear gain in efficiency and/or level of motivation we need to look more closely at the science behind this phenomenon. The science that forms the background to this area of interest can be found in labour models generated in the early 20th century. The following is a brief explanation of how labour supply models can show insight into the aforementioned phenomenon.

In most labor supply models, in this case that formulated by Butler [11], work is considered to be undesirable. Hours not worked are called leisure hours with leisure time being the desirable. The problem of the worker appears as follows:

Maximize Utility (of a worker) = Function (Income, Leisure)

$$\text{Labor hours} + \text{Leisure hours} \leq 16 \text{ waking hours.}$$

The above expressions point to the fact that utility of a worker is a function of their waking hours divided between income and leisure hours. The above model may be expressed in terms of labor hours 'L' as follows:

$$\textit{Maximize } U = f(wL, 16\text{-}L)$$

where 'w' is the real wage rate. In order to understand the above model, indifference curve analysis may be used to examine the effects of a changing wage rate on the number of labor hours supplied by an employee. The indifference curve is a representation of an individual substitution ratio, or the opportunity cost of labor versus leisure time. Details of the indifference curve analysis have not been discussed in this paper [5], [11]. As shown in Fig. 1, there is a relational link between employee motivation and successful project delivery. Human resources are the core in delivering projects through underlying complex processes. Positive employee motivation across the project organization is important in delivering projects with its target business objectives.

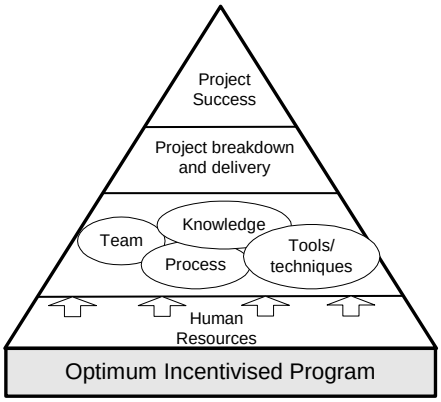

Fig. 1. Optimum motivation and project success

IV. Best Practice Analysis

The theory that motivating workers has an effect on worker output has been well researched and documented. Study shows that the incentive programs greatly increase performances though the use of tangible incentives (money, gift, travel). While the incentive programs have a direct effect on the performance level of employees, it is also evident that the same has direct impact on the quality and quantity of work performed [6]. While the appropriate incentive program has direct impact on work performance, cost of de-motivated employees is not quite well quantified due to the variance of efficiency between each individual employee. Extensive research has been evident in addressing a question "*do workers subject to incentive programs have increased output*" with numerous subjective solutions. The general consensus is that incentive programs definitely do increase the output of workers. However, regular review in updating and remodeling such programs in order to suit the ever changing work environment is quite intrinsic in project based management approach.

Construction industries especially in developed countries are generally the dominant industry where any slowing or reduction in productivity can have wide impact on world economy. Study shows due to the size of the construction industry, productivity changes within it have the significant direct effects on the national productivity and economic well-being of the United States. In the 1997, the United States' industry accounted for roughly 7% of the GDP for new projects, and about 10% including refurbishment and repair works [5]. Perceptions of productivity trends vary widely within engineering, academia, industry and economic analysts. The declining labour productivity in construction industry which has been evident in recent survey in Australia and

overseas justifies in devising appropriate and sustainable incentive programs across the industry.

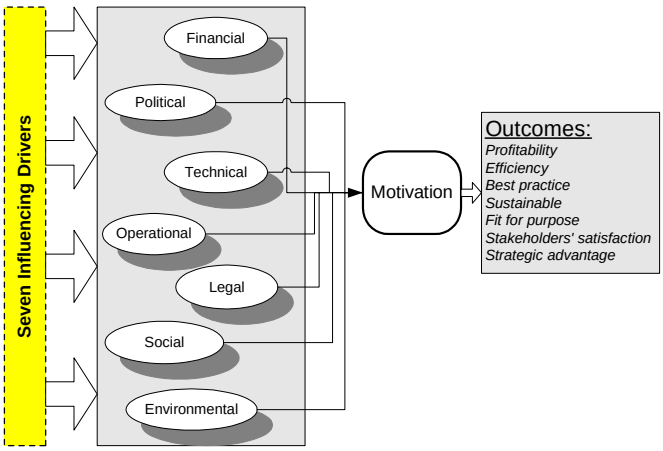

Fig.2. The seven motivational drivers

In order to get the benefit of skilled members' performance in a team based assignment, motivation is the key to success. In the domain about motivation, there has been a good advancement of the knowledge by numerous researchers over last two decades. Harada [6] utilised 7 factors in ascertaining team members' motivation in his current research. In order to attain the target objective in a successful project, organizational capabilities must be equipped with appropriate incentivised program. These organization capabilities are the functions of people, processes, knowledge and tools and techniques as shown in Fig. 1.

Fig. 2 shows 7 wide spectrums of motivational drivers influencing project's success. These broad drivers have been identified based on the review of the current best practices as well as the ongoing industry practices. In order to derive the project's performance outputs, motivational drivers must be understood in terms of their underlying dependencies and integrate them accordingly for holistic decision making process.

V. Framework and Methodologies

Selecting the most appropriate alternative from a set of alternatives and eliciting the consistent subjective judgment from the decision makers in the selection process require a holistic analysis. In general, this selection process is more effectively performed with the aid of a computerized decision support system. Fig. 3 shows an integrated framework incorporating the capability for cross interactions and information exchanges across influencing parameters in a project based approach. Information sources on a project vary from legacy databases to knowledge based expert judgments. The proposed system allows systematic evaluation of such databases in defining and customizing feasible alternatives as input to the Multi-criteria Analysis (MA) framework.

Fig. 4 shows the MA framework designed to facilitate the decision makers to choose the appropriate linguistic values to express their judgments and preferences and to fully explore the inter and intra relationships between the criteria, the alternatives and the ranking outcomes of the alternatives. The adopted technique is the Analytical Hierarchy Process [3] that permits qualitative data to transform into pairwise comparison data. It is essentially a framework within which the decision makers can express a complex building engineering problem using a hierarchical model. The model enables the decision problem to be broken down into individual elements whose functional interactions and relationships with each other can then be analyzed. The optimum solution is devised out of given feasible solutions at the top level in the hierarchy model.

The linguistic values with their fuzzy representations are incorporated into the knowledge base with the proposed DSS framework. A decision maker is first asked to select the linguistic value of his/her preferences before the system presents all available values that are internally connected with their fuzzy representations.

In case the decision makers are not sure about their

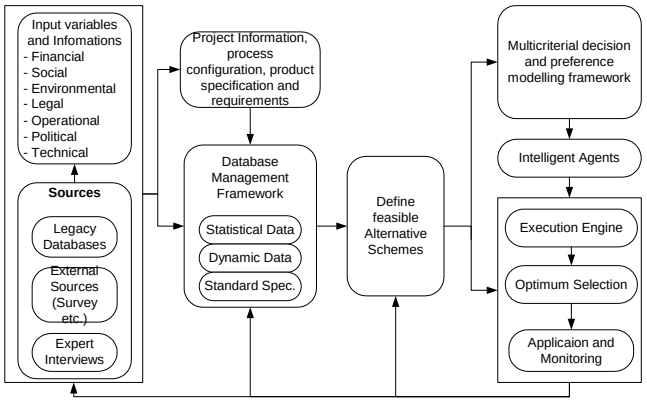

Fig. 3. The system framework

preferences, a default linguistic value is presented. If the verbal terms used in the scale are different from the terms the decision makers want in describing the nature of the criteria in the decision making problem, the system framework should be able to match the scale with past information from the knowledge base repository [4]. This is achieved by incorporating an intelligent agent in the system (Fig. 3). The differences of opinions or domain knowledge can also be captured in the model using fuzzy and Neural Network models. The overall framework has been developed using Matlab and available toolboxes facilitate the required computations [12]. The multi-criteria analysis is performed on

multi-level criteria and sub-criteria against feasible technical solutions as shown in Fig. 4.

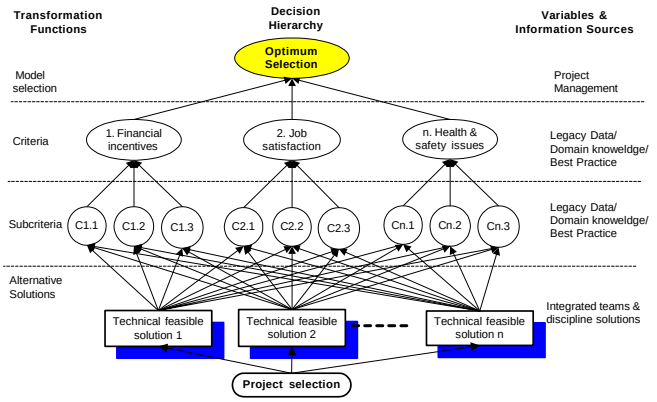

Fig.4. Hierarchical Links between Alternatives and Criteria

VI. Approach Adopted

In order to benchmark the proposed automated system for decision analysis, an extensive fieldwork has been undertaken as part of a few honours theses under the authors' supervision [5]. There were two methods used for the analysis of the data collected in the field. The first is the descriptive approach with direct interpretation of the survey results and the second is the multicriteria by using the dataset in establishing the hierarchical structure for multicriteria decision evaluation.

A. Descriptive Research

Observation is a primary method of collecting data by human, mechanical, electrical or electronic means. The researcher may or may not have direct contact or communication with the people whose behaviour is being recorded. Observation techniques can be part of qualitative research as well as quantitative research techniques. In this research, a large amount of survey questionnaires developed capturing the knowledge in practice.

When people are being surveyed, ethical issues such as personal data was treated very confidentially. Extreme care had been taken for maintaining the privacy of individuals with the view that the participants are aware that at no stage they are under any pressure and that information contained/ collected through the surveys is to be grouped and no individual survey will be used in evidence to prove the hypotheses under study.

The survey was conducted in two phases as follows:

i) Phase I

This survey was developed in the earlier stage with the aim in getting a feel for what types and to what scale incentive programs exist within the construction industry. For the sake of brevity, the survey and the results have not been included in this paper and are available from the author on request. The data collected from this survey served as casual research mainly and thus its results are mainly interpretive. The survey has served its purpose insofar as allowing for the development of survey in Phase II.

ii) Phase II

This survey was developed aiming to perform the Analytical Hierarchy Process on the collected data. When designing a survey that uses AHP to analyze data there are certain criteria that need to be conformed too. The survey was developed so that respondents ticked a box corresponding to a particular area of employee attributes. For example, a respondent was asked to tick the box of either "*Motivation*", *Commitment*" or "*Skill*" when asked "*I believe increased training will most likely positively affect my level of….*" These three responses corresponded to the three sub criteria that were set when undertaking the AHP analysis and allow for the direct interpretation of results [3],[7]. The survey provided clear and concise responses to the questions posed.

This study undertakes a large amount of casual research within the bounds of its descriptive research surveys. Therefore the team can never be sure that the solution is '*correct'* however it is believed that by asking a number of widely varying questions the team has been able to null out the effect of this phenomenon.

B. MCDM Research

i) AHP Decision Tree

The Fig. 5 represents the hierarchy inherent in AHP that was used to find the optimum solution. The optimum solution is at the top of the decision tree followed by a series of Criteria that affect the outcome of the solution, through the use of technical solutions. The various solutions and their relationship between criteria is the process by which the AHP matrices are determined, and the technical solution, which fits the optimum solution, is chosen [3].

The AHP tree diagram for this particular study also includes sub criteria. These sub criteria formed the basis for the questions that formed the aforementioned survey. It is interesting to note that there is not always a relationship between the sub criteria, criteria and the technical solution, in this case the sub criteria are said to be independent of a particular criteria [6],[7]. The diagram in Fig. 5 is the diagrammatical representation of the AHP method used to solve the optimum solution.

The sub criteria that are shown in Fig. 5 in second level of decision hierarchy are abbreviated so that the diagram works visually. The following list is a breakdown of what the sub criteria are and why they were chosen to be part of this analysis.

- *SC 1: Training*: The level of training directly influences the level of output of an individual and it is therefore a relevant sub criteria. Training influences the level of skill that the employee possesses, however it can also be

perceived as negative due to the fact that corporations that are known as "*trainers*" are often used for this purpose and then employees often move on to new firms.

- *SC 2: Number of Labour Hours*: The number of hours that an employee works may or may not increase their level of output. Combined with other sub criteria such as improved work environments however the number of labour hours worked will increase output.
- *SC 3: Level of Experience*: Level of experience is fairly self explanatory as to why and how it effects the level of output of an individual.
- *SC 4: Work Environment*: Of those participants that responded to survey number 1, the greatest percentage of respondents reported that work place environment was the number 1 factor that influenced their motivation at work, and therefore it must be included as a factor effecting level of output.
- *SC 5: Rewards*: Rewards here refers to the giving by the employer of an object or cash to an individual employee in thanks for work completed. It is important that this factor be included as it relates directly to the idea of incentive programs. Rewards are the most basic form of incentive programs.
- *SC 6: Superannuation*: An individual level of commitment to an organization, can be effected by their level and payment of superannuation. Superannuation in its basic form is not a key factor influencing the level of output due to the fact that the majority of employees in Australia take it for granted, however bonus superannuation payments do often for part of incentive programs and therefore it has been included within the analysis.
- *SC 7: Level of Salary*: The salary level of an individual, or rather the change in salary through successive pay reviews is an influence on the level of a worker output, even if literature suggests that it is of diminishing importance as a motivation tool.
- *SC 8: Challenging nature of Occupation*: There has been much research that suggests that the challenging nature of an employee's job is a large factor in their motivation. It doesn't relate to incentive programs however it is important in this study to not bias the questions towards ones that only relate to the implementation of incentive programs.
- *SC 9: Employee Innovation*: The innovative nature of employees is the greatest resource that an employer can tap. Incentive programs that encourage innovation can be very helpful in this regard.
- *SC 10: Employee Efficiency*: Efficiency by its definition means to increase the level of output with a fixed amount of resources, it stands to reason therefore that it is important for employees to be efficient in order to increase output.
- *SC 11: Prospect of Promotion*: The prospect of being promoted, is a large motivator for many employees, however it can't be guaranteed to motivate all employees, due to the fact that many employees do not aim to "climb the corporate ladder" the purpose for its inclusion is to ensure once again that the survey is not biased toward the implementation of incentive programs.
- *SC 12: General Manner*: This question was posed within the survey due to the effect that an individuals personality has on their output, it is generally recognized that people with a good attitude perform better in the workplace.
- *SC 13: Communication Skills*: Communication skills are perhaps the most important skill that an employee can posses. Incentive programs have no bearing on this however it is included due to the fact that a good communicator often can allow for the efficient functioning of a workplace.

ii) Technical Solutions and the Optimum Solution

The optimum solution for this study is "*To Increase the Output and Work Productivity of Employees in the Construction Industry*". This study proposes that the use of incentive programs can achieve this. Conducting surveys and interviews, then interpreting these results with a non-proven formula, will not allow the author to draw any valid conclusions. However, using a well-defined and tested process such as AHP will allow for significant results to be achieved.

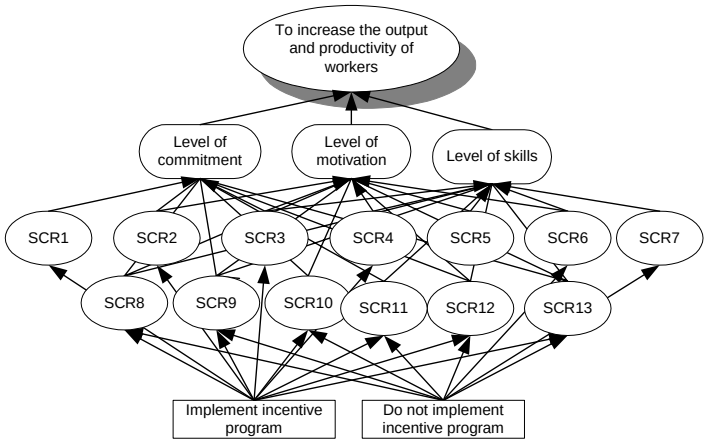

Fig. 5. Criteria and Subcriteria for AHP Analysis

Technical solutions, as contained within AHP analysis, are in place as a means of determining the most preferable method of achieving the optimum solution. The technical solutions are indirectly related to the sub criteria to which it is tested. In this study the author seeks to prove whether or not incentive programs increased worker output as against not implementing such a system. Therefore the two technical solutions tested were: "*to implement an incentive program*", or "*not too*" as shown.

iii) AHP Calculations

AHP calculations were computed using survey in Phase 2 and performed using Microsoft Excel as a dry run in developing the overall framework.

The sequence of calculations involves the analysis of the three criteria, followed by the analysis of the sub-criteria, which leads to ascertaining the appropriateness of the technical solutions in reference to the optimum solution.

iv) Three Criteria Analysis

The three criteria used for this study were Commitment, Motivation and Skill. The three criteria was decided upon in reference to the Optimum Solution and in conjunction with interviews conducted with senior management personnel within the Construction Industry.

The first step in the AHP analysis was the creation of the "*Three Criteria Matrix*". This involved tabulating the results from the interviews with the senior management personnel. Eight senior management personnel, from Bovis Lend Lease and Walter Construction Group in Sydney, Australia, were interviewed and quizzed on the optimum solution, "*To Increase the Output and Work Productivity of Employees in the Construction Industry*". The interview was aimed at establishing key employee traits that contribute heavily to the Optimum Solution. Three traits were consistently iterated from the interviews, Commitment, Motivation and Skill. Secondly, the senior management was required to compare these three traits against one another in reference to the Optimum Solution. Example of the priority matrix for criteria against a single technical solution is shown in Table I below. The rest of the calculations and results have not been shown for brevity.

TABLE I
SAMPLE OF A PRIORITY MATRIX

Three Criteria – Priority Matrix			
	Commitment	Motivation	Skill
Commitment	1.00	5/3	6/2
Motivation	3/5	1.00	5/3
Skill	2/6	3/5	1.00

The results were then transformed into a "*Three Criteria*" Matrix. The matrix is a requirement for the AHP process, to establish a "*priority matrix*".

VII. ANALYSIS AND RESULTS

The literature review undertaken in this study revealed the fact that incentive programs have achieved significant improvements in employee productivity. It was indicated however that incentive programs were not widespread within the construction industry. This research aimed at determining whether or not the implementation of incentive programs within the construction industry would be a wise decision for management. This discussion focuses on the results of both the surveys and the analysis of the data through the process of AHP. In the first stage of this research, the results from survey one were not analyzed through any finite process, however some of the interesting results are worth mentioning here.

It is a general perception of the public that flashy names or badges do not affect construction workers. However close to half of the recipients noted that it was important for their employer to have a high profile. This result may have been slightly biased due to the fact that the majority of the construction workers surveyed worked for large companies. The question begs 'what does such a response have to do with incentive programs?' The answer is that feelings associated with pride are one of the key factors in employee motivation, if an employee feels that his/her work may affect their employer in a major way then studies have found that their work will be of a higher standard.

Other interesting results included the fact that many construction workers responded that they were de-motivated when they worked under the influence of management pressure, suggesting that common industry practices of 'stand over' tactics should not only cease due to legal reasons, but also because it was in the best interests of the employer that such practices ceased.

Only eight percent of respondents were against workplace recognition. In an industry dominated by males, and a very 'macho' workplace, it is unexpected that almost all respondents wanted to be recognized and thanked for their contribution. This result is very interesting due to the fact that it opens the door for all kinds of recognition based incentive programs.

The most significant results to come from this research are the influence of incentive programs on workers motivation. Over eighty percent of respondents said that being part of an incentive program was important to them, and that if subject to incentive payments over ninety percent of respondents said that their work productivity would increase.

Two of the most expected responses came however in regards to respondents feeling about their current contract and what type of incentive reward they would be most happy with. The majority of respondents said they were unhappy with their current contract and that they would most prefer cash as the form of incentive bonus.

Survey 1 definitely leaned toward the implementation of incentive programs, however further analysis, that was not possible with the data from Survey 1 was needed. Hence Survey 2 was developed so that its results could be directly analyzed through the use of AHP.

The results of the survey however were very interesting. In order to understand the significance of the results one must understand the criteria on which the analysis was based. In the process of researching for the literature review it was discovered that the level of output of an employee was directly related to three board criteria being an employee's level of *Skill*, *Motivation* and *Commitment*. With these factors in mind the author sorts the opinion of employers as to how to rank these criteria. The consensus of employers was that the three criteria were of differing levels of importance, from the most important to least important; Commitment, Motivation and then Skill. This fact is very important in the analysis of

this study as incentive programs are much more likely to affect an employee's level of commitment and motivation then their level of skill.

The result of the surveys was then inputted into Excel spreadsheets containing the AHP matrices. The result of the analysis was very conclusive as to whether or not incentive programs would increase the level of output of workers. Technical solution number 1 - *Implement incentive programs* came out at a weight vector of ***0.62*** versus technical solution number 2 - *do not implement an incentive program* with a weight vector of ***0.38***. In other words the survey suggested that it would be a wise decision for an employer to implement an incentive program.

As discussed, this research will further be investigated with the aim of setting up an automated system. Various legacy databases and data from outside sources will be integrated and analyzed for appropriate project specific incentive programs for successful project delivery.

VIII. CONCLUSION

Employee output is the single greatest driver behind business success. The labour intense nature of the construction industry most certainly then relies very heavy on its workforce to remain profitable. This study has proven that it is possible for employers to determine what factors will influence employee motivation and thus increase employee output. The preliminary study has shown the development of a survey, the analysis of the data with the sub-optimal conclusion that the incentive programs in the construction industry will increase the output of industry employees. This study has opened the door for further studies to be conducted to investigate appropriate the incentive programs that will best suit the construction industry.

The hypotheses and the preliminary results presented in this paper are based on a joint industry study. It has been realised that the proposed hypothetical model may still be inadequate due to insufficient quantity of measured data at this preliminary stage of the research. However, with the understanding and ongoing effort, the author is quite hopeful in integrated the human elements in projects business success.

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