The Impact of Job Design and Motivation on Employee Productivity as Applicable in the Context of Sri Lankan Software Engineers: A HR Perspective

Fernando A.
Informatics Institute of Technology (IIT)
anisha9f@yahoo.com

Ranasinghe G.
Informatics Institute of Technology (IIT)
gayathri@iit.ac.lk

Abstract
The Sri Lankan IT\textsuperscript{1} industry provides diverse clients with quality software solutions under tight timeframes and budgets. However, many organisations encounter the challenge of ensuring employees are adequately skilled, whilst facing the difficulty involved in identifying motivation factors of skilled employees and ensuring proper design of jobs. The research study mainly focuses on understanding the motivation and job design concepts adopted for Sri Lankan software engineers and the subsequent impact of these factors on their productivity from a human resource perspective. The findings indicate that positive correlation exists between job design and motivation and between motivation and productivity. Applicable attributes of each factor are depicted in the derived conceptual model. A proposed web-based DSS\textsuperscript{2} would measure motivation levels and ensure effective job design, in comparison with productivity levels. By measuring these factors, the performance of a software engineer can be driven, which would benefit both the organisation and the individual.

Keywords: Job Design, Motivation, Productivity, Software Engineer

\textsuperscript{1} Information Technology
\textsuperscript{2} Decision Support System
Introduction

1.1 Background

The Sri Lankan software industry has been growing at a rapid pace and aims to cater to the global demand for quality software in shorter time periods and within a reasonable budget. The software industry along with the ICT industry accounts as the fifth largest export earner in the country and is growing rapidly. It is predicted to critically contribute to the socio-economic development of the country (Mendis, 2010).

However, while aiming to cater to industry needs, the software companies in Sri Lanka face a great challenge in ensuring that employees are productive as essential soft skills such as communication and leadership skills in employees are not adequate to meet industry expectations. Hence the challenge is to ensure that adequately skilled professionals take up existing vacancies in organisations. Thus, this inadequacy is caused due to high job dissatisfaction and high labour turnover (ICTA, 2007). Another factor identified through the pilot study, that leads to lower employee productivity is the general incapacity on the part of HR managers to identify specific factors which motivate SEs.

Motivated employees are critical for organisations to survive (Smith, 1994). This is because motivated employees indirectly drive an organisation’s efforts and invariably play an important role in an organisation’s success. However, factors which affect an employee varies greatly and changes with an individual’s needs and goals over time (Lindner, 1998) and as such it is important to know what factors motivate a particular employee to be driven towards the best performance category.

According to Chilton et al., (2010) the performance of IT workers varies diversely due to rapidly changing environment needs. Thus, an IT worker performs at an optimum level when such an individual has professional needs that are catered to by various factors of job design present. This would increase productivity of the employee.

Increased flexibility of skills, faster career and individual growth, appropriate methods of learning and challenging work greatly enhance employee productivity. Productive employees generally indicate a high level of job contentment and showcase an efficient job design. Job design is the method in which aspects of a job are structured (Slack, 2007). Various techniques of job design exist such as job rotation, job enrichment and job enlargement. Argyris (Accel-team, 2010a) states that an organisation is formed to achieve goals or results

---

3 Information Communication Technology
4 Human Resource
5 Software Engineers
and this effort is best achieved when it is a collective effort. As such, each individual needs to have a job design that appropriately meets the needs of the individual. Employee productivity has been a critical factor in the success of organisational endeavours, be it projects or organisational functions. Likert (Accel-team, 2010b), states that in aiming to meet goals such as high profitability, effective labour relations and high productivity, an organisation should make the most of their human resources.

1.2 Research Problem

Employee turnover has been a significant drawback to the Sri Lankan software industry and it has increased greatly from 6.6% to 13% in 2006 (ICTA, 2007). One of the reasons for this high turnover rate is the high level of job dissatisfaction and poor motivation levels within employees in the IT industry. These low levels are caused by issues such as low job security, lower salary scales and poor job design. Overall, the end result is an inefficient and a less productive workforce. Thus, the high turnover rate seen in the industry is a growing cause for concern, as the quality of deliverables produced by these organisations, varies according to the skill levels and needs of employees. The programming and software engineering sector had 28% of demand and is one of the largest sectors of the IT industry as shown below. Therefore, software engineers are determined to be the employees who have greater impact and influence on productivity within a software organisation.

Figure 1- Demand for Software Engineers (Adapted from the ICT Workforce Survey: ICTA, 2007)
In addition, there is a significant concern in managing and retaining skilled resources, in emerging IT offshore industries in the Asia-Pacific region (PricewaterhouseCoopers, 2006). A considerable amount of strategic effort in global IT outsourcing organisations is targeted at improving job design and roles of skilled personnel, in order to combat rising difficulties in retaining skilled resources. Moreover, in the Sri Lankan IT industry, a surplus of job opportunities and limited skilled resources exists (Gunawardana, 2007). This provides skilled resources such as software engineers, the option of seeking and switching to organisations that best cater to their needs and expectations which would motivate them to work at optimum levels.

There is also a clear inadequacy of skill levels in software engineers, most of which are related to soft skills as shown in the figure below. Thus, there is an importance placed on the improvement of such skills and adequate procedures should be in place to monitor the improvement of skill levels. If properly managed, software engineers could be developed into multi-skilled personnel enabling organisations to produce quality software.

![Image of Table]

**Figure 2- Inadequacies in Software Engineers (ICTA, 2007)**

Furthermore, the adoption of job design and motivation concepts of software engineers in software development organisations mostly occur on an ad-hoc basis. Thus because of the severe time constraints, employees such as project managers and software engineers work in, this is an aspect that is given less priority and often neglected. Another area of concern is the generalised assessment generated in the existing methods of assessing software engineer productivity, where some organisations use team level performance to ascertain individual performance as per the findings of the pilot study.
Therefore, there is a significant need to obtain information regarding the motivation and job design levels of software engineers, which can then be used in turn to drive the productivity of such individuals. The critical research question posed would be: “What is the impact if any, of motivation and job design towards productivity as applicable in the context of Sri Lankan software engineers?”

### 1.3 Purpose of Study

To understand the factors of job design and motivation and its impact on employee productivity as applicable in the context of software engineers in Sri Lanka.

### 1.4 Objectives

1.4.1 To understand the factors affecting software engineer productivity in terms of motivation and job design characteristics in the Sri Lankan software industry.

1.4.2 To assess the impact of job design on motivation of Sri Lankan software engineers.

1.4.3 To assess the impact of motivation on productivity of Sri Lankan software engineers.

1.4.4 To provide recommendations to improve software engineer productivity via enhancements to motivation and job design aspects in the Sri Lankan software industry.

### Literature review

#### 2.1 Theories

According to Bloisi (2007), motivation is “a conscious decision to perform one or more activities with greater effort than other competing activities” (pp.196). Luthans (2003) describes motivation to be “a process that starts with a psychological or physiological deficiency or need that activates behaviour or drive that is aimed at a goal or incentive” (pp. 249). Mullins (2002) depicts motivation to be a “study concerned with why people behave in a certain way” (pp.418). Thus in the context of this study, motivation is derived from the above definitions, to be a study of the factors influencing the behaviour of software engineers in the IT industry.

Motivation is a difficult factor to quantify and measure. If it can be measured, then motivation levels of employees can then be driven towards achieving goals. Thus motivation levels as such, are not monitored in a structured manner within the industry. It is quite difficult to find out what motivates individuals due to drastic differences in personality and
the needs of the individual. Any practice (an improved motivation technique) is carried out on an ad-hoc basis.

Job design (Mullins, 2002) is said to be “concerned with the relationship between workers and the nature and content of the jobs, and their task functions” (pp.658). In addition, job design is how an individual’s job, workplace and how any interface with technology is structured (Slack, 2007). Therefore in the context of this study, job design will be defined to be the method in which a software engineer’s job is planned, incorporating the factors that affect the nature and content of the roles played and tasks carried out. It is also noted that proper communication of roles and responsibilities of software engineers, especially with respect to projects is imperative for a productive performance, both individually and team-wise.

Productivity is defined as follows:

\[
\text{Productivity} = \text{efficiency} + \text{effectiveness (1)}
\]

where \(\text{efficiency} = \frac{\text{time completed}}{\text{time estimated}}\) (2)

and \(\text{effectiveness} = \frac{\text{completed work}}{\text{allocated work}}\) (3)

This is determined to be the most applicable as it identifies and aims to measure factors which significantly impact productivity of software engineers and can be effectively captured in organisations.

Productivity is also a difficult factor to quantify because there are a lot of external factors such as project constraints which impact it. The current measures used in the industry to measure productivity is not representative of the individual effort as it provides a representation of the actual team effort.

Every project manager\(^6\) (PM) essentially plays an HR role in projects, as he or she has to manage the personnel involved in the project. Thus the traditional role of an HR manager is played by both the HR manager and project manager. In practice, managers do not have the time to analyse and carry out detailed tasks, for example with respect to motivating employees due to time constraints. Thus, this aspect is significant because in reality managers use ad-hoc, informal approaches (which are mostly based on their gut feeling) to maintain good co-worker relationship and drive the motivation of individuals.

Furthermore, there is a significant need to measure and monitor productivity and motivation and implement a structure for job design in the industry. One of the main causes of software project failure is determined to be motivation (Sharp \textit{et al.}, 2009). The decrease in value of

\(^6\) Project Manager
various motivation factors (Westlund et al., 2008) is determined to impact job design factors such as autonomy and task identity. Thus, it can be deduced that a decrease in motivation which would be as a result of a lack of proper job design would overall impact productivity.

### 2.2 Theoretical Framework

According to the ICT work force survey, it lists various factors for motivation from an employer’s point of view as shown below.

**Table 1- Top 10 factors that help retention at different stages of the career (Source: ICTA, 2007)**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Less than 1 year of experience</th>
<th>1-3 years of experience</th>
<th>4-8 years of experience</th>
<th>Over 8 years of experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Good compensation plan</td>
<td>Good compensation plan</td>
<td>Good compensation plan</td>
<td>Good compensation plan</td>
</tr>
<tr>
<td>2</td>
<td>Good work environment</td>
<td>Clear career path</td>
<td>Rapid promotion</td>
<td>Flexibility in hours</td>
</tr>
<tr>
<td>3</td>
<td>Rapid promotion</td>
<td>Incentives for gaining certifications</td>
<td>Flexibility in hours</td>
<td>Challenging job</td>
</tr>
<tr>
<td>4</td>
<td>Flexibility in hours</td>
<td>Raises</td>
<td>Challenging job</td>
<td>Good work environment</td>
</tr>
<tr>
<td>5</td>
<td>Raises</td>
<td>Challenging job</td>
<td>Clear career path</td>
<td>Stability of company</td>
</tr>
<tr>
<td>6</td>
<td>Challenging job</td>
<td>Training</td>
<td>Good work environment</td>
<td>Overseas travel</td>
</tr>
<tr>
<td>7</td>
<td>Training</td>
<td>Clear career path</td>
<td>Training</td>
<td>Clear career path</td>
</tr>
<tr>
<td>8</td>
<td>Clear career path</td>
<td>Incentives for gaining certifications</td>
<td>Incentives for gaining certifications</td>
<td>Incentives for gaining certifications</td>
</tr>
<tr>
<td>9</td>
<td>Incentives for gaining certifications</td>
<td>Stay current with technology</td>
<td>Stay current with technology</td>
<td>Co-worker relationship</td>
</tr>
<tr>
<td>10</td>
<td>Stay current with technology</td>
<td>Co-worker relationship</td>
<td>Co-worker relationship</td>
<td>Job security</td>
</tr>
</tbody>
</table>

However, this analysis fails to include the impact of job design as well motivation factors from an employee point of view. As such there is a growing need in organisations to find out what employee motivation factors are most effective and the aspects of efficient job design as it is expected to increase productivity of the software developer as well as aid in the organisation’s growth.

The productivity of the IT worker is influenced by changing environment factors (Chilton et al., 2010). This should be considered in how a job role is structured. However, this is greatly impacted by a manager’s ability to cater such needs. Chilton et al., (2010) also uses the P-E fit theory (Person-Environment Fit Theory) to explain that when the connection between an individual and the environment that individual works in, is highly suitable, this leads to higher performance and satisfaction levels.
The MOCC model shown below, takes into consideration variances in motivation caused by moderators such as contextual factors and individual personality. Contextual factors can be determined to be aspects such as the nature of the job and culture of the work environment. Hall et al., (2008) also states that intrinsic motivators stem mainly from the management of tasks, autonomy and task significance. Beecham et al., (2007) lists the ideal characteristics of a software engineer. By identifying the characteristics of an ideal software engineer, the relevant motivation factors can then be deduced and then related to the expected job design factors. However, this model has not been developed for software development organisations in Asia.

Figure 3- The enhanced MOCC model of motivation in software engineering (Source: Sharp et al., 2010)

Luthans (2003) states that due to the fast growth and rapidly changing technology, job design is also impacted. Changes in technology support the growth of telecommuting jobs as well as the difference between what constitutes work and home hours is not as clear cut as before. Panchak (2003) also provides support in that the importance of work carried out by an individual, motivates the individual as well as having clear roles and responsibilities and an increase in autonomy of an individual.

Tessem and Maurer (2007) express views pertaining to how indirect and formal structured communication occur in large teams and how these factors improve motivation and job satisfaction of individuals. They also point out that the culture of the project team stabilizes over time (in the case of the same project being carried out over a longer duration). This

---

7 Motivators, Outcomes, Characteristics and Context Theory
leads to maturity of the project team where job design aspects (such as the job characteristics model hold true) of such teams may significantly impact motivation.

Song and Wang (2009) present an initial analysis of software engineer characteristics, which they have deduced to vary, based on contextual and personality factors. They conclude with the fact that contextual factors impact extrinsic motivation while personality factors impact intrinsic motivation. Thus, it can be determined that characteristics of an individual play a part in influencing what motivates a particular individual.

Moreover, motivation factors influencing software engineers in the Sri Lankan context as per the ICT Workforce Survey Report (2007) and from the findings of the pilot study are categorised accordingly below.

Table 2- Categorisation of Motivation Factors

<table>
<thead>
<tr>
<th>Intrinsic Motivators</th>
<th>Extrinsic Motivators</th>
<th>Contextual Motivators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenging job</td>
<td>Salary increments</td>
<td>Work environment</td>
</tr>
<tr>
<td>Staying current with the technology</td>
<td>Incentives for rapid promotion</td>
<td>Co-worker relationship</td>
</tr>
<tr>
<td>Clear career path</td>
<td>Good compensation plan</td>
<td>Flexibility in hours</td>
</tr>
<tr>
<td></td>
<td>Overseas travel</td>
<td>Job Security</td>
</tr>
<tr>
<td>Training</td>
<td></td>
<td>Stability of the company</td>
</tr>
<tr>
<td>Other perks</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Motivated employees are vital for organisations because of the critical part played by the employees in producing goods or offering services. Thus, it is of critical importance to ascertain the factors that motivate these key players. Job design is another aspect of importance as the way in which a job is structured influences the work carried out by the individual. It could result in better team work and produce multi-skilled personnel with a higher job satisfaction. Hence, it is of value to provide jobs structured in a method that caters to the individual’s preferences. This when done on an organisation basis, will enable the organisation to achieve its end goals.

Employee productivity is a critical aspect that directly impacts an organisation’s success. Its relation to motivation is shown via the function below:

\[ \text{Job Performance} = f(\text{ability})(\text{motivation}) \]
Considering that generally all software developers have a minimum entry qualification of a degree level as indicated during the preliminary investigations, ability is taken to be constant. Thus motivation is determined to directly affect job performance.

In addition Hackman and Oldham’s Job Characteristic Model\(^8\) clearly shows the linkage between these three aspects. The job characteristics mentioned are influenced by job design aspects such as an individual’s accountability, specialisation and new challenging tasks. As such it is shown that job design impacts motivation which in turn impacts productivity.

**Figure 4- Job Characteristic Model (Adapted from Emeraldinsight.com, 2010: Hackman-Oldham job characteristics model.)**

<table>
<thead>
<tr>
<th>Core Job Characteristics</th>
<th>Critical Psychological States</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skill Variety</td>
<td>Experiences meaningfulness of work</td>
<td>High Internal Motivation</td>
</tr>
<tr>
<td>Task Identity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task Significance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomy</td>
<td>Experiences responsibility for the outcomes of work</td>
<td>High Quality Performance</td>
</tr>
<tr>
<td>Feedback from the job</td>
<td>Knowledge of actual results from work activities</td>
<td>High Satisfaction with Work</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Moderators</strong></td>
<td>Employee’s Growth Need Strength (GNS)</td>
<td></td>
</tr>
</tbody>
</table>

2.3 Conceptual Framework

Based on the literature evaluation, factors present in existing motivation models such as the MOCC model, JCM model and productivity concepts mentioned are taken into consideration. These models are chosen because of its applicability and relation to the software engineer’s context.

The following conceptual model was drawn from the literature review and industry survey conducted.

---

\(^8\) Job Characteristics Model
These factors identified were tested within the industry survey from a HR perspective relating to a software developer. It shows how the job design, motivation and productivity domains are aligned. The factors most relevant to the Sri Lankan IT industry are stated along with each component, as per the findings of the industry survey.

The job design component of the conceptual model does not contain the factors, task significance and task identity as per the factors in JCM. This is because these two factors were perceived as not being as crucial elements by software engineers, in terms of how the job is designed, as opposed to the preferred factors (autonomy, skill variety and feedback).

The motivation component consists of the factors listed above (using the MOCC Model) as these were determined as the factors that would have the greatest impact on motivation of software engineers and categorized under intrinsic, extrinsic and contextual motivators. Other factors such as co-worker relationship, training, compensation and other perks were deemed secondary in preference and thus eliminated from the categorisation.

In terms of productivity, both effectiveness and efficiency of an individual were deemed to be most important. Effectiveness is mostly impacted by factors such as leadership and communication whilst efficiency is greatly influenced by aspects such as team commitment, motivation, individual performance and team culture.

Furthermore, based on the literature review findings, another aspect of critical importance is how job design and motivation correlate to productivity. Hence, an improvement in job design is assumed to result in high levels of motivation which in turn would result in high productivity.

2.4 Hypotheses

The following hypotheses were developed to be tested.

- **H1**: An increase in job design levels increases motivation
- H2: An increase in motivation levels increases productivity
- H3: An increase in job design levels increases productivity

Methods

3.1 Sample

A total of 7 companies took part in the questionnaire survey as part of the industry survey targeting software engineers which tested factors affecting job design, motivation and productivity and any correlation between these variables. Out of the total respondents, 29% were from Company A, 21% were form Company B, 17% each were form Companies C and D respectively, whilst Company E accounted for 9%, Company F accounted for 5% and Company G accounted for 2%. A sample size of hundred valid responses was received while indicating a response rate of fifty-six percent.

In addition 88% percent of the users surveyed were in the age range of 20-30% whilst 12% were between the ages of 31 to 40. Majority of the respondents (69%) had a graduate degree as the educational background, whilst 10% had a post-graduate qualification. The types of roles played by the SEs included 31% percent of software engineers, whilst 33% were associate software engineers and 5% were senior software engineers. The level of experience included 51% who had experience levels less than 2 years whilst 31% had between 2 and 5 years experience and 12% had between 5 and 10 years experience. Majority of the respondents displayed moderate motivation and productivity levels whilst emphasizing on effective job design.

In the expert questionnaire sent out to personnel in the industry with a wide knowledge and experience base, there was equal distribution between the companies A, B, C, D, F and G. 83% of the respondents were between the age range of 31-40, 50% possessed a graduate degree and 67% were project managers having 10 to 20 years of experience.

In the interviews conducted with HR managers, experts, academics and PMs, 37% was from company E, whilst 29% was from company D, with rest of the companies having 9% equally divided amongst them. In addition from the sample interviewed, 31% were project managers, 25% HR managers and 25% academics. Furthermore, the size of the organisations interviewed were also listed, such as 43% from organisations with a size between 100 and 300, 29% between 40 and 100 whilst 14% between 300 and 500 and also between 500 and 1500 employees.
3.2 Methodology Used

The research methodology chosen was the deductive method of research, where a theory or a conceptual model is investigated and derived via confirmed observations. The deductive method was chosen because there are various existing models for motivation and job design criteria. It is required to evaluate each of these existing models in order to identify factors specific to the Sri Lankan context since IT is a specialized industry which requires knowledge intensive workers. Hence, factors affecting employee job design, motivation and productivity subsequently differ based on the context.

A combination of quantitative and qualitative techniques was used to carry out the industry survey. A quantitative technique such as an industry wide questionnaire targeting the main stakeholder group of software engineers was carried out. Qualitative techniques in the form of interviews were conducted with industry personnel such as HR managers and PM managers. Opinions from industry experts were captured also via one-on-one interviews done with them.

The HR managers deal with resources on a daily basis and provided issues that they encounter frequently, whereas the experts provided a high level view of information based on the general picture of how things are carried out within organisations. Academic viewpoints were also captured via a series of interviews with respected academics with relevance to IT aspects as well as the business aspects. The process of triangulation was used in order to obtain and validate the data. Information collected from questionnaire respondents were validated by the interviews conducted, which in turn were validated during discussions on the findings of the research conducted.

Results and Discussion

4.1 Relationship between job design and motivation

There exists a significant positive correlation between job design and motivation with a value of .572 which has been determined via the statistical correlation analysis done. Correlation analysis was conducted by computing the Pearson’s correlation coefficient between various components as listed in the hypothesis. The factors autonomy, feedback and skill variety are preferred in terms of the user’s preference and applicability to the Sri Lankan context. This is because the ability to carry out decision making, use feedback provided and being multi-skilled, ensures that the job role of a SE is designed effectively. Thus it is derived that job
design and motivation have a strong relationship where an increase in job design results in an increase in motivation.

4.2 Relationship between motivation and productivity
Furthermore, there exists a significant positive correlation between motivation and productivity with a rating of 0.805. All three types of motivation factors, intrinsic, extrinsic and contextual factors are rated highly among user’s preference and applicability to the Sri Lankan context. In addition, when considering a few of the selected variables, in the instance of a SE who is well paid, possessing a variety of skills and has job security, it can be deduced that these factors will positively impact the individual’s productivity. Thus, it can be determined that motivation and productivity are linked, where an increase in motivation results in an increase in productivity.

To further substantiate the relationship between motivation and productivity, linear regression analysis was conducted between the two variables. The following is the derived equation:

\[
\text{Productivity} = 0.45 \text{Motivation} + 2.27
\]

Therefore productivity, the dependent variable increases by 0.45 when motivation, the independent variable increases by one. In addition, a constant value of 2.27 denotes the value of productivity when motivation is zero. Thus an increase in motivation results in a positive increase in productivity.

4.3 Relationship between job design and productivity
However, after analysing the relationship between productivity and job design, weak positive correlation was seen to exist with a value of 0.061. An increase in job design did not necessarily increase productivity. Thus job design and productivity are determined not to have a relationship between the two variables because, of the weak positive correlation shown.

4.4 Factors Derived
- An increase in job design levels increases motivation
  This is clearly seen to hold true as majority of the respondents display a high level of job design satisfaction with respect to the job design factors tested such as autonomy, skill variety and feedback.
For example, a SE who uses numerous skills and has a fair share of decision making would be more content than an individual who does not. This invariably is reflected in the outlook and drive of the person.

- **An increase in motivation levels increases productivity**
  This is determined to hold true because higher motivation levels as tested results in better productivity, where factors such as intrinsic, extrinsic and contextual motivators such as the work environment, salary increments and a challenging job are deemed to be of importance. For example, a highly motivated SE would be inspired to produce work that exudes quality, thus being productive as a result.

Therefore, it is derived that relationships exist between job design and motivation and also between motivation and productivity because of the significant positive correlation shown. Thus when aspects of a SE’s job are effectively designed, it positively impacts the motivation of the individual. In turn, when the motivation factors are of significant levels, it positively impacts the productivity of the SE.

However, motivation and job design are not the only factors influencing productivity, but are determined to be the most influential from a HR perspective based on the results of the pilot study. Furthermore, the definitions of motivation and job design derived from the literature review hold true whilst, the productivity definition of efficiency and effectiveness was modified where effectiveness which incorporated input and output of work was modified to incorporate the lines of code (LOC) versus defects ratio as it is a more accurate estimate of effectiveness. However efficiency which was the time output over time input ratio remains true.

**Conclusion and Recommendations**

*5.1 Key Findings*

Various characteristics that form the ideal software engineer profile have been established as a result of the study. A profile type of the software engineer can be derived based on these characteristics which could be used to trigger and drive the overall productivity of an individual. These include a keen ability and interest to learn, the right attitude towards working, commitment, passion for work as well as good technical and soft skills.
It is also important to note the contribution software engineers play in the industry, where high importance is placed on the role played by them. The role played by software engineers is crucial because the work carried out by SEs primarily result in the production of software. Thus, this influences the organisation’s ability to develop software. In addition the scope and outlook for Sri Lankan software industry has also improved, creating a continued demand for quality software developed locally.

Moreover, the components tested, namely motivation and job design were found to significantly impact productivity. Job design is concerned with the structure of the job and the role played by the software engineer. Mostly this was communicated on an informal basis with respect to teams. However, certain characteristics such as autonomy, feedback and skill variety were rated important by the respondents of the survey. Motivation of an individual influences a person’s quality of output. Factors of motivation rated important were work environment, salary, flexibility, challenging job to name a few. Thus the objective of understanding factors of motivation and job design affecting productivity was achieved.

These findings are further facilitated by the example that a software engineer’s motivation is relative to job design. For instance, an entry level SE would look to possess a high degree of skills and feedback so as to have faster career progress, which could be the main source of motivation. However, in the instance of a senior SE, the individual may prefer a high degree of autonomy and flexibility, as the main source of motivation may gravitate towards factors such as work-life balance. Thus, this coincides with the finding that an increase in job design levels increases motivation levels and the objective of assessing the impact of job design on motivation was also achieved.

Productive software engineers are crucial to a software development organisation’s ability to grow and sustain. This is because in a knowledge-intensive industry, one of the key aspects that determines an organisation’s ability to sustain, is its ability to ensure that its core employees, the software engineers are productive most often than not.

Therefore, if employees are highly motivated such as via challenging work or good teamwork, employees feel the need to perform well. Thus this aspect is line with the finding that an increase in motivation levels impacts productivity positively and substantiates the objective of assessing the impact of motivation on productivity.
5.2 Strategic impact of findings

Having established the impact of motivation and job design on software engineer productivity, further analysis is done to determine the overall impact on the software engineer as an individual.

Job Design

Providing software engineers with greater, but controlled autonomy would instil higher self-esteem. If software engineers undertake a variety of tasks of differing skill levels, they would be more flexible in handling tasks requiring multiple skills. This would also increase the value of such an individual. Appropriate feedback provided to SEs would also provide them with valuable insights and direction in their project role.

In practice, SEs may play multiple roles in different projects. Hence, this concept of job design could be tailored to the specific job role they may play in projects based on the type of project undertaken. Therefore, an appropriately designed job role and the ability to measure its effectiveness would benefit the software engineer as the individual is able to actively determine its usefulness.

Motivation

Motivation factors can be a source of inspiration that would drive the performance of an individual. Intrinsic motivators such as a challenging job and a clear career path would each spur the interest of the individual and would instil the individual’s passion for the job. This type of motivation for a software engineer would provide the backbone for a high level of continued interest for the job at hand and would also improve productivity.

Extrinsic motivators such as incentives for training and salary increments would suffice a software engineer’s desire for obtaining physiological needs. However, this needs to be appropriately matched with competitors’ levels in order to ensure the organisation has a competitive advantage. In addition, organisations should present software engineers with various opportunities to improve and extend skill levels. This would result in a multi-skilled individual who may be better fit to take up vacancies in stretch-fit roles.

Contextual motivators such a good work environment, flexibility of work, job security and stability of the company would contribute to a software engineer’s motivation for the current
job role. Hence, it could determine the level and duration of commitment shown by the individual because these are factors that a software engineer deals with on a daily basis and poor contextual motivation would contribute to an overall low level of motivation. Thus, contextual factors, more or less serve like hygiene factors, where the absence of it could lead to low productivity, but the presence of it could sustain normal productivity levels.

**Productivity**
Levels of productivity in terms of effectiveness and effectiveness can be used as a comparison to motivation and job design levels measured. These levels provide a quantitative evaluation of productivity, from a HR perspective. This can be used in combination with qualitative aspects of measurement such as team performance to better provide a balanced view on productivity of individual software engineers. The analysis of such data could also help the management as well as the software engineers to be aware of productivity levels and to continuously improve as a result in a proactive manner.

In addition, these levels of productivity when measured could act as a source of individual performance. It could be used as input when assessing performance progress for either the performance appraisal process when evaluating past performances or the resource management process when selecting resources for projects.

### 5.3 Recommendations and future work
This section aims to fulfill the objective of providing recommendations which would improve software developer productivity in relation to job design and motivation, based on the findings of the research study carried out. A recommendation which would aid managers in ensuring that the software engineers are productive is a web based DSS system, named iTRACK. This could be deployed as an intranet and could be developed to enable software engineers and managers to monitor motivation, productivity levels and to ensure job roles and responsibilities are communicated.

iTRACK is primarily designed to be used as a self-evaluation tool for software engineers, who could use it as a method for continuous improvement. Both software engineers and project managers are users of the system, where the software engineer can input their motivation levels and assess their job design via a series of interactive questions. These questions would validate the level of factors in each component (motivation, job design and
productivity) and provide an aggregate value for each component based on the weight and selected value of each factor. The self-evaluation aspect would be carried out via the corrective actions feature, where if a particular factor (example: skill variety) for a component (example: job design) is low when compared to the standards set by the organization for that particular job role, guidelines on how to improve are provided as a result.

Moreover, project managers can input values for efficiency and effectiveness measures in terms of their productivity, which could be used to compare against values of motivation and job design. PMs can also view the aggregated values for each component and when captured and collected for a sufficient period of time, it would serve as input to decision making, because they can view trends in levels of motivation, productivity and aspects of job design. This is in addition to being able to monitor these levels which previously were not captured and processed in a useful and periodic manner. Via this functionality, the levels of motivation, productivity and job design criteria can be assessed, captured and reports presented on the progress.

Furthermore, enhancements to the iTRACK concept such as implementing past lessons learnt and ideal levels of motivation and job design can also be retrieved via data mining using an implemented data mart. This would serve as a useful indicator tool to both SEs and PMs because of the fact that these levels would be monitored on a periodic basis and are specific to the organisation. Thus based on the derived characteristics, vital performance data specific to the organization can be collected and analyzed to ascertain the type of software engineers which best suit that particular organization. This can then be used as an input to drive the performance or the recruitment process of SEs, resulting in a substantial benefit to the software development organization.

Other additions include incorporating social media or mobile application technology where, the IT solution could be deployed as an application. This would increase accessibility and usability of the solution as it would be available as and when required by the software engineer. This could also lead to wider adoption of the concept, thereby further standardizing the methods of measurement used as the type of individuals and organizations would increase.
Future work such as further research could be conducted into the effect of each factor under different organization and team environments. This would standardize the level of measurements used in motivation, job design and productivity as the research carried out was limited to companies in the Colombo district.

Similarly analysis can be carried out in implementing the conceptual model, in other knowledge-intensive industries where the performance of a key resource is vital to the success of an organization. Investigations incorporating a 360 degree evaluation of the assessments with evaluation of levels from a relevant colleague, project manager, a higher level manager as well as self-evaluation could be useful in standardising the levels as well. This would also add value and provide a well-balanced assessment of motivation and job design levels in comparison to productivity levels.

References


