

Application of Empirical Modelling to Business Performance and Management Modelling

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Abstract

Day-to-day business activities are full of challenges which hinder business performance if not managed effectively. A challenge faced by many organisations is the management of project-oriented business. A project-oriented business can be divided into key categories which determine the performance of the organisation. One of these universal categories in any organisation is the investments a company makes. A major investment is in the employees themselves. It is evident that a lot of money can be spent on employees alone. Hence, it is essential to gather knowledge about the Return of Investment (ROI). This paper introduces a way of evaluating employee performance based on three key indicators, productivity, utilisation and profit. A model developed to evaluate performance is introduced and the benefits of Empirical Modelling are discussed explaining why the tool is unique and advantageous for successfully modelling an environment heavily influenced by human characteristics.

1 Introduction

Day-to-day business activities are full of challenges which hinder business performance if not managed effectively. A challenge faced by many organisations is the management of project-oriented business [1]. This is due to a various number of factors such as the different skills possessed by employees, client requirements, deadlines, etc.

A project-oriented business can be divided into key categories which determine the performance of the organisation. One of these universal categories in any organisation is the investments a company makes. A major investment is in the employees themselves. It is evident that a lot of money can be spent on employees alone. "Employee costs today can exceed 40 percent of corporate expense" [2]. Hence, it is essential to gather knowledge about the Return of Investment (ROI).

For a business to ensure profit and sustain their current state, it is fundamental that their employees are

productive and utilised efficiently. Unfortunately, people's work ethics and commitments vary. Therefore it is imperative to be able to evaluate employee performance. For example; in a consultancy business, salaries are paid towards time allocated to projects. Hence some projects are priced up based on hourly rates (e.g. time and resources). Utilisation of employees in this case will provide an indication of the ROI. Whereas for fixed cost projects, utilisation is not enough to provide accurate profit figures (e.g. productivity or the ability to undertake the work within the predicted time scale determines the profit margin). In both cases, when deadlines are not met, penalties may apply to the business which will affect reputation and profit. This shows the importance of evaluating performance of employees, and their ROI to be able to set financial targets as we learn from day-to-day challenges within the business (e.g. increase or decrease of number of projects, utilisation of assets, deadlines, profit, etc). Currently many companies base performance evaluation on utilisation alone. This does not allow

identification of skills and productivity of individuals. For example, a situation can arise where two employees have a similar work load, however one of the employees is able to complete the same project quicker due to higher skills and/or experience (i.e. increased productivity which will lead to decrease of utilisation). This will allow the employee with higher skills to undertake more project work which will again increase his utilisation. Although utilisation of both employees may be very similar in this scenario, it does not provide any figures of the actual ROI made by each employee. Therefore the two key indicators; utilisation and productivity, are important for business performance evaluation of employees.

1.1 Content

This paper introduces the application of Empirical Modelling to business performance evaluation. Section 2 offers a detailed explanation of key performance indicators and their role within Empirical Modelling. The next section goes on to introduce the model and discuss the benefits of ‘introducing the human dimension’. It explains the approach which is based on ‘state as experienced’ which could offer invaluable information highlighting the skills possessed by individuals and their worth to the company. It would also help management with the allocation of projects, i.e. allowing optimisation of resources.

2 EM and Key Performance Indicators

2.1 Profit

Every organisation has an estimate of the ROI expected from the employee. For instance, if a company decides to pay an employee a salary of x a month, they could calculate that this salary is affordable or the employee is worth this sum only if

the work done by the employee generates profit that meets company financial targets (e.g. $3x$). An employee needs to be productive and utilised in order to obtain this revenue.

Companies account for the mutual human attribute of idle time by setting their expected utilisation of each employee to a reasonable level. For example, if the time period considered is 22 days (one working month) then management may decide that 20% of idle time (4.4 days) is acceptable, i.e. the company has set a 80% utilisation level.

The observable, utilisation accounts for the acceptable accumulated level of idle time. Hence the model accounts for all of the trivial time occupying observables that could be classified as idle time in a work environment.

‘Daily rate’ is a figure paid out by the client for an employee per day. The daily rate charged depends on the employee’s skill and experience. As mentioned above, a project is priced up based on the time and resources required. Hence, utilisation needs to be efficient for the employee cost to be covered by the client only. Otherwise, employee costs would be covered by company profit, which is obviously defeating company targets.

Therefore the net profit (ROI) generated by each individual depends on their daily rate, figures of productivity, utilisation and the profit of each project.

2.2 Utilisation

The business dictionary defines utilisation to be “The proportion of the available time (expressed usually as a percentage) that an equipment or system is operating.” [3] In Empirical Modelling, utilisation of an employee is an observable for which a value can be assigned. The value of this observable is calculated using the formula:

$$\text{Utilisation} = (E_t / A_t) * 100$$

where E_t is the expected time for completion of a project (including idle time) set by the manager and A_t is the actual time taken till completion by the employee. The observable, utilisation, is acceptable if greater than or equal to the value set as the threshold by the company. It is when an employee exceeds the expected time that the company starts losing money. Clearly there exists a dependency between the observables utilisation, expected time and actual time.

The maximum value of utilisation based on contracted hours is 100%. For instance, if an employee allocated a project with $E_t = 22$ days, determines A_t to be 22 days, this implies 100% utilisation. Whereas their peer in the same situation who determines A_t to be 11 days faces two possible situations dependent on productivity. The utilisation value could decrease to 50% if not given any further work or it could be sustained with similar productivity levels for the extra workload. In the case of an employee exceeding the deadline, the utilisation will remain 100% if the employee is continually working throughout the evaluated time period. Implying that the employee may not be capable to complete this project. Utilisation can exceed 100% if an employee takes on overtime. A company can use this calculation to determine whether overtime is necessary. However if it remains below 100% this indicates that the overtime is unnecessary and the company are losing profit through this employee.

From these scenarios it is evident that utilisation is not the sole indicator of performance. Combined with productivity, utilisation can offer information regarding general attributes of an employee or the current situation of an organisation. For example an employee could not be utilised because they are overqualified for the job and they are finishing it too quickly or it could simply be because there is not enough work to be distributed.

An agent affecting the observable utilisation is the amount of work a company has. If the company is well known, or there is high demand for the service they are offering, it can be very common that they are frequently receiving unexpected work from clients. Introducing this agent, changes the state of the business since employees' utilisation levels increase. Clearly, it is very likely that productivity will increase hand in hand. Although human responses vary and there may exist a threshold value where the constant increase of this agent will lead to employees feeling overwhelmed with the workload and their productivity could decrease, significantly affecting the profit. This scenario emphasises the importance of Empirical Modelling. It highlights the ability of the model to provide clear indications of the right balance between the workload and productivity. Since agents arise unexpectedly, the ability of empirical modelling to carry out on-the-fly alteration is extremely beneficial in acknowledging this agent instantly. This helps the user understand how the state of the business is changing and identify possible problems which need to be acted upon quickly.

2.3 Productivity

The productivity of an employee is another observable which is dependent on many human and non human characteristics. Human characteristics are observables including: mood, personal circumstances, interest in job etc. The latter considers observables such as the expected time for completion of the project and the actual time spent till completion.

An agent which can affect the productivity of an employee is motivation. Motivation can increase through many different incentives like pay rise, praise and training. A motivated employee means an individual who is eager to complete their work.

Thus an increase in motivation suggests an increase in productivity. However this is not always the case. Very often an organisation spends a significant amount of money on motivation, e.g. training workshops, with the expectation that it will have a direct effect on employees and consequently increase the revenue. If the training has no effect, the company loses profit via this method of motivation.

Clearly a relationship between the two observables is definitely established, but there is another human characteristic that cannot be observed which needs to be considered in order to identify the dependencies between the observables. This characteristic is the unknown. It is not possible to predict an employee's response to this agent. Again this highlights the importance of Empirical Modelling, as any other modelling language would not be able to incorporate this parameter. This unknown characteristic can be understood through 'state as experienced'. If an employee is motivated with a particular incentive, their productivity will increase whilst their utilisation decreases. These observables will clarify whether the agent of motivation has had an impact and changed the current state of the employee's performance in a way which increases their ROI.

3 The Model

The model concentrates on analysing the performance of one employee through the observables; productivity, utilisation and profit. As explained above, each observable is essential in gaining an overall understanding of an employee's characteristics and contribution to the business.

The model has been developed to consider fixed cost projects for reasons mentioned in the introduction. During the course of this research Dafea was consulted for an equation to relate utilisation, pro-

ductivity and profit in terms of application in industry. With 6 years of experience in software development of management tools, he has suggested the equation below. According to his knowledge this equation has not been used in the development of software applications due to the limitations of existing software development tools such as the modelling of different agents and human aspects. A problem that Empirical Modelling can address competently. The equation used in the model to calculate the actual net profit per time period is given below.

$$\text{Net Profit (ROI)} = (X * Y) - (D * (1-Z) * TP)$$

Where:

X = productivity (%percent)

Y = profit from project

Z = utilisation within a specific time period (usually 22 days)

D = daily rate input, a value based on salary and overheads (cost of employee during idle time)

TP = Time period the profit is calculate over

The target net profit is specific to an organisation depending on the standards they deem acceptable regarding the productivity and utilisation of an employee. If the user assumes productivity is 100% and utilisation is 80% the target net profit equation is obtained by substituting X = 100 and Z = 80 into the above equation.

An example of the equation is shown below. Consider one employee working on three projects where the expected time for each project is 5 days and the profit per project is £3000. The daily rate of the employee is £250. The time period used here is one working month (22 days).

Using the equation for productivity and utilisation stated earlier in the paper, if the employee completes each project in 5 days, their productivity is 100%. As they have worked for 15 days out of 22, their utilisation is 68%. Therefore:

$$\text{Net Profit Per Month} = 15,000 - (250 * 0.32 * 22) = \text{£}13,240$$

and

$$\text{Target net profit} = 15,000 - (250 * 0.2 * 22) = \text{£}13,900$$

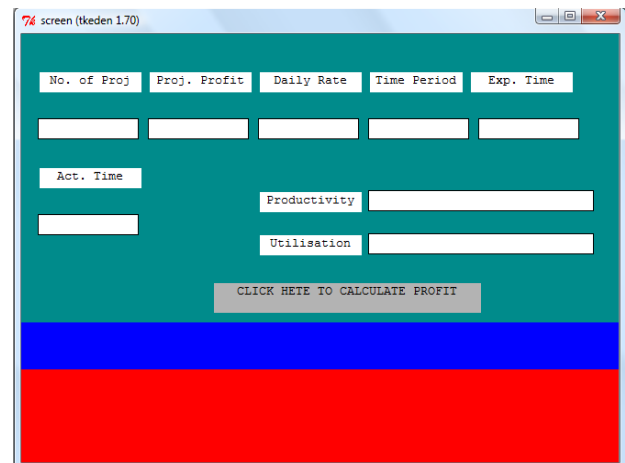
This shows that regardless of the productive employee, the company is not meeting their targets because the employee is not utilised enough. The model allows the user to realise the current state of business performance and the value of the employee. It can also be used as the basis for important business decisions. As in the above example, if utilisation levels are low for every employee it is clear that the company does not have enough work, or that management has inaccurate expectations of projects. Therefore immediate action has to be taken to prevent further loss of profit. More time may be needed for business development to increase the workload, or the company has to consider alternative possibilities such as salary decreases and/or redundancies.

If the agent of more projects is introduced, the state of the model will change since the productivity of employees could increase/decrease. The state will reflect qualities of individual employees, highlighting which individuals work best under pressure, who cannot handle the stress, and where the balance lies in the optimisation of employee productivity.

Rasmequan, Roe and Russ define a Decision Support System (DSS) as “a system in which the human user plays an essential, interactive role.” [4] Since the model is based on three main observables, employee utilisation, employee productivity and profit

generated by employee, the model can be viewed as a DSS. Figures generated by the model can influence business decisions including the projects allocated to an employee, salary increases/decreases, redundancies, company investment in motivation etc. Thus, highlighting the importance of it.

The model was created using version 1.70 of the tkeden tool. Below, is the interface of the model. The simple interface caters for ‘the non-specialist’ user. This feature of Empirical Modelling is vital in a business environment. A strategic DSS is “likely to be taken by the most senior managers and so ease of use, or the possibility of end user development is highly desirable”. [4] It also allows the user to easily adapt the model to account for agents like motivation and unexpected increased/decreased workload.



4 Advantages of an EM Approach

“Project management is at once one of the most poorly understood areas of management.” [5] Overcoming this problem, involves an analysis of the observable that determines the success of a project, employee performance. Key indicators of performance evaluation are to a certain extent subjective. Without an existing equation, the only way of mak-

ing sense of employee behaviour, is to interactively construct “an artefact that maintains a symbiotic relationship with the modeller’s construal of a phenomenon. It is particularly appropriate for new phenomena, or phenomena which are as yet little understood.”[6] This highlights the need for Empirical Modelling in addressing issues that have been put aside due to the lack of sufficient tools.

Many distinguishable features of Empirical Modelling shine through during the process of interacting with the model. A major advantage is that the user can learn from the model without having any prior knowledge about the expected result. For example, if an agent (e.g. motivation) is introduced to the system, there is no predetermined equation known to the user making them aware of a possible expectation. Interacting with the model allows the user to experience the state through the construal and understand the situation clearer because of the visual aspect of the model. Again, emphasising a key feature of understanding ‘state as experienced’.

There is no button on the model that automatically introduces an agent but the model allows for this indirectly. If the user suddenly experiences an influx of work, they can experience this simultaneously in reality and through the model. Thus, the user has the ability to change the model themselves regardless of whether they have experience of programming. This is a remarkable feature of Empirical Modelling which does not exist in other applications.

Rasmequan states the technical benefits of Empirical Modelling. “On the management aspect of EM the main benefits are the high potential for reuse of model components and the relatively low maintenance cost because of the correspondence of the modelling process to mental modelling.” [7] These advantages directly apply to this business model. Retaining company profit is a primary concern for

all organisations and Empirical Modelling assists this target.

As mentioned in the previous section, the easy to use interface is a major benefit in a business environment. Sterman [4] discusses the problem that current tools can only be used by trained employees. One of the solutions Sterman offers is the intensive involvement of management in the process of building the model. This is a costly solution and could have a detrimental effect on profit. However Empirical Modelling offers a solution that is ready to be used and understood by any user.

5 Conclusions

This paper has provided the reader with an in-depth description of the key indicators of performance evaluation and has highlighted the benefits of an Empirical Modelling approach. To date no definite equations exist to link human aspects to business aspects such as productivity and motivation. Empirical Modelling techniques have shown that it is possible to create a model that can consider these different aspects on the fly and offer a system that can predict business behaviour from different states of the model. This model not only allows ‘humans to think with computers’ but makes it possible for a whole business to think with them. It has the ability to educate the user through the change of state and teach them about organisation requirements.

Future work for this model could be to enhance the features so that it can be applied to a range of different businesses, for example, manufacturing. Different issues arise in this sector which would need to be thought about carefully. For instance, the observable productivity, would be determined by the output of a machine which is consistent and probably optimal. These limitations would need to be considered. More development on this particular model

could include other agents such as mood, personal circumstances etc.

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