# Stress and Manpower Risk Management: Tracking Anomaly in Productivity with Stress based Fatigue Allowance Allocation

**Shwetank Parihar**
Research Scholar, Department of Management Studies, Indian School of Mines, Dhanbad, India
**Chandan Bhar**
Professor, Department of Management Studies, Indian School of Mines, Dhanbad, India

**Nishit Srivastava**
Research Scholar, Department of Management Studies, Indian School of Mines, Dhanbad, India

## Abstract

*The paper links justified stress based fatigue allowance allocation with project risk analysis. The paper deals with the introduction of conceptual framework of developing an efficient allowance management system for service sector based stress measurement, since in the service sector unlike any conventional manufacturing assembly line there are drastically different stress levels for different individuals working in the same firm. We are hereby advocating a tailor made system of rest allowance allocation in accordance to stress level of each individual. A structural framework is given here for allocation of rest allowance in service industry according to the need of the subject to increase the productivity and upkeep of motivation for any individual.*

## Introduction

The main thrust on this paper is that with the increase in the number of Information Technology companies that provide service to the clients and follow a strict nature of deadlines, the level of stress cannot be simply related to the amount of time spend on the system. It's a two way loss when allowances are pre deigned on the basis of time the operator goes for breaks even when he is able to work efficiently for longer time period without breaks and on the contrary his productivity is also diminished when the rest allowance is provided at the same interval even if he is working in a more stressed condition on that day for a particular project.

Apart from this there are many personal reasons also that affect the productivity of an individual even if the external conditions are constant, so due to all the above present difficulties it becomes necessary to provide the rest and fatigue allowance only at the time it's exactly needed. On our consultation with experts in the IT industry we have collected view point on the flexible time limits, work from home and other practices for stress risk reduction, a common point of view emerged from them is that the pressure conditions are

sometimes soaring high and sometimes its low but the time break schedule is fixed. This problem is faced by almost every industry professional in IT sector involved in system based work, we have devised a method in this paper which talk about tailor made allowance system in which the worker is compensated more in the time of greater stress and less in the time of easy going. The paper explores a method which is based on need based package of rest break, here we have devised a system in which the overall rest allowance is treated like a drug which is given in required quantity to cure the stress and like any drug the quantity is of utmost importance here also and is decided and monitored. The system suggested is experimented on a group of voluntary students involved in different types of computer based works with different time lines and different stress levels and the reading are being noted for number of faults and the amount of stress, which is measured by simply measuring the heart rate of the volunteers, same students are tested for fixed time interval based rest allowance and tailor made rest allowance system and the results are analyzed and the remarks are suggested.

**Literature survey**

The stress measurement and allowance allocation are the two main problems before us, the stress measurement is dealt by many authors like Muaremi et al. (2013) in which a combined methodology for stress measurement is done under which the smart phone and wearable devices are used for better stress measurement, information from various sources like audio, physical activity, skin conductance change due to stress and heart rate are taken into account and they are compared with the normal values at night, in this study joint effect of smart phone and sensors are done in order to have a complete analysis and have a real time data for processing. Two different stress levels are monitored that is short time and long time stresses. Accuracy rate of nearly 61 % is provided by such an arrangement.

Methods like Galvanic Skin Response (GSR) are also suggested to measure stress for any individual, in this device the skin conductance change is detected by the sensor due to sweat realized during high stress conditions, a small device that can be worn in the wrist or as an arm band is very helpful in tracking the stress of an individual, but the problem with such an arrangement is that in case of works where there is no sweat change it starts showing less sensitivity. Studies also stress that the long term effect of any continuous or high frequency periodic stress is very harmful. The human body also shows very fine recovery signs once the break is given at the optimal point. The data from GSR is only reliable when it is coupled with other stress data sources. Various device packages are present in the market that wirelessly monitors the stress levels and other working factors of any worker and sends the data to the central processing unit. We can use such devices to exactly monitor the stress level of any individual dynamically in real time.

The autonomic nervous system controls and monitors the stress levels of any individual and in times of greater stress they control heart beat and relaxes the body, but in order to keep track of this system several arrangements are being done in order to have a complete monitoring of this nervous system, sensors are present in market which can measure the skin response and they are used in alignment with various acceleration sensing devises which tells us the level of activity performed which is also a measure of stress. With 90 % of the subject data as input to this system we can have an accuracy of 80% of stress detection. Balci and Aghazadeh (2004) has also studied the effect of breaks on performance, muscular load and perceived discomfort in computer base work. The study also deals with usual complaints that occur in body due to such a working, short breaks are advised in order to have a complete analysis of stress effects. Out of the different work break patterns the shortest one that is 15 / micron is found to be most productive as seen from the output of this study.

Boucsein and Thum (1997) has given a design for rest scheduling especially for computer based work, where short breaks are found to be more effective, in this study along with the basic methods like heart beat, electro-thermal activity recording is also done for mapping of emotional strain component under stress. Long breaks are found to be less productive than shorter ones, the recovery from stress in both the cases of predictable and unpredictable interruptions is done, in fact the study also gives the result as longer breaks in the end of the shift and shorter at the start of the shift are also more effective. So what we can hereby inference is that the allocation of short breaks that too with the level of stress can be very helpful in deciding the productivity level of the work. The same benefits of micro-breaks is also advocated by McLean et al. (2001), which says that the micro-breaks taken at an interval of 20 min can be having a very positive effect on lowering of stress, Myoelectric signal (MES) are seen as the main factor for stress measurement in this study, amidst the various studies the major point of consideration found in this one is that it is more concentrated on the lowering of discomfort of the worker, with small work breaks without affecting the productivity. Lund and Mericle (2000) has determined the fatigue allowance for a grocery store order selectors in order to reduce the long term stress, in this study also it's referred that fatigue allowance can directly affect the stress level. Uniform quantification cannot be used to assess fatigue for each worker this study clearly mentions this, that's why there is need for tailor made allowance system. The different metal stress factors are also discussed in this paper and their importance is also shown for the need of allowance.

Fatigue calculation for different working scenarios, industries and muscle groups is given by many authors like Henning et al. (1996), Ma et al. (2011) and El ahrache and Imbeau (2009). The common finding among them all is that the placing of fatigue allowances on each time is of utmost important whether it's physical or mental work. Even the effect of feedback on the break also affects the productivity of the worker and this directly indicates

the strong connection between stress and working capability.

Studies also show that real world scenarios are very different in practical conditions and the allowance management is sometimes dealt very roughly. Mathematical models are also present for the calculation of ideal allowance but how to distribute it and the level of change that needs to be done for any particular worker is very difficult to achieve. So in nutshell what we have found is that stress affects the productivity in a very high fashion and it's absolutely necessary to have a real time allowance division and distribution for higher level of productivity. Need for exact time calculation for fatigue allowance implant is also felt so that stress recovery can be complete with more productivity.

The suggested methodology in this paper thus runs on the fact that there is a need for development of developing a framework of rest allowance allocation for service sector that is exactly optimized for each worker, cause in service sector the level of stress is more, difficult to measure and highly depends on person to person. The framework given below is highly useful for such service sectors where the stress level is high and the working projects are complex and constantly changing.

**Research Methodology**

The sample population of 30 post graduate students is taken for different set of stress conditions, and then they are given data entry and checking related jobs in the first phase of the study done in the systems laboratory. The observations are done, and then the same students are invited voluntary for participation in the study. On next day on the same time and keeping the other conditions of work same, they are given complex projects to complete in short time intervals and the rest allowances are given according to the heart beat mapping from ECG (Electro Cardio Graph). The same procedure is repeated for second phase of the study in which the same sample subjects are again undergoing the process but this time with fixed time based rest allowance.

Volunteers are given two first set of file in which they have to mark the vowels in a paragraph on the system only, in the other shift same volunteers are given to perform the same exercise but with lesser time (half an hour less) to create stress.

In the second part of the experiment the same volunteers are set to perform the experiment but this time the rest allowance or the breaks are superimposed by researcher only, which is when the cardiograph reading reaches a peak for a particular time and worker starts showing signs of exhaustion, but the total tenure of the breaks are kept same in both the cases.

**Results**

The results are shown in Table 1 and Table 2. Both these tables are very helpful in showing the effect of stress based breaks in between the projects and they can be very well integrated with the conventional software project management cycle and can be successfully implemented in other such type of service projects.

**Table 1. Comparison between Fixed time allowance and Flexible time allowance (with stress)**

| Fixed time allowance | | | | Flexible time allowance | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| With Stress | | | | With Stress | | | | | |
| Sr no | Student no | Task completion Time (min) | No of faults | Sr no | Student no | Task completion Time (min) | No of faults | Reduction in faults | % reduction |
| 1 | MBA 1 | 120 | 10 | 1 | MBA 1 | 120 | 9 | 1 | 10 |
| 2 | MBA 2 | 120 | 12 | 2 | MBA 2 | 120 | 5 | 7 | 58.33 |
| 3 | MBA 3 | 120 | 5 | 3 | MBA 3 | 120 | 4 | 1 | 20 |
| 4 | MBA 4 | 120 | 8 | 4 | MBA 4 | 120 | 3 | 5 | 62.5 |
| 5 | MBA 5 | 120 | 7 | 5 | MBA 5 | 120 | 2 | 5 | 71.43 |
| 6 | MBA 6 | 120 | 6 | 6 | MBA 6 | 120 | 8 | 2 | 33.33 |
| 7 | MBA 7 | 120 | 4 | 7 | MBA 7 | 120 | 3 | 1 | 25 |
| 8 | MBA 8 | 120 | 5 | 8 | MBA 8 | 120 | 4 | 1 | 20 |
| 9 | MBA 9 | 120 | 5 | 9 | MBA 9 | 120 | 4 | 1 | 20 |
| 10 | MBA 10 | 120 | 5 | 10 | MBA 10 | 120 | 4 | 1 | 20 |
| 11 | MBA 11 | 120 | 10 | 11 | MBA 11 | 120 | 8 | 2 | 20 |
| 12 | MBA 12 | 120 | 9 | 12 | MBA 12 | 120 | 8 | 1 | 11.11 |
| 13 | MBA 13 | 120 | 8 | 13 | MBA 13 | 120 | 7 | 1 | 12.5 |
| 14 | MBA 14 | 120 | 10 | 14 | MBA 14 | 120 | 9 | 1 | 10 |
| 15 | MBA 15 | 120 | 12 | 15 | MBA 15 | 120 | 5 | 7 | 58.33 |
| 16 | MBA 16 | 120 | 10 | 16 | MBA 16 | 120 | 8 | 2 | 20 |
| 17 | MBA 17 | 120 | 15 | 17 | MBA 17 | 120 | 9 | 6 | 40 |
| 18 | MBA 18 | 120 | 8 | 18 | MBA 18 | 120 | 5 | 3 | 37.5 |
| 19 | MBA 19 | 120 | 15 | 19 | MBA 19 | 120 | 4 | 11 | 73.33 |
| 20 | MBA 20 | 120 | 15 | 20 | MBA 20 | 120 | 10 | 5 | 33.33 |
| 21 | MBA 21 | 120 | 4 | 21 | MBA 21 | 120 | 3 | 1 | 25 |
| 22 | MBA 22 | 120 | 7 | 22 | MBA 22 | 120 | 6 | 1 | 14.29 |
| 23 | MBA 23 | 120 | 5 | 23 | MBA 23 | 120 | 4 | 1 | 20 |
| 24 | MBA 24 | 120 | 3 | 24 | MBA 24 | 120 | 2 | 1 | 33.33 |
| 25 | MBA 25 | 120 | 2 | 25 | MBA 25 | 120 | 2 | 0 | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 26 | MBA 26 | 120 | 5 | 26 | MBA 26 | 120 | 3 | 2 | 40 |
| 27 | MBA 27 | 120 | 4 | 27 | MBA 27 | 120 | 5 | 1 | 25 |
| 28 | MBA 28 | 120 | 8 | 28 | MBA 28 | 120 | 9 | 1 | 12.5 |
| 29 | MBA 29 | 120 | 9 | 29 | MBA 29 | 120 | 7 | 2 | 22.22 |
| 30 | MBA 30 | 120 | 10 | 30 | MBA 30 | 120 | 5 | 5 | 50 |

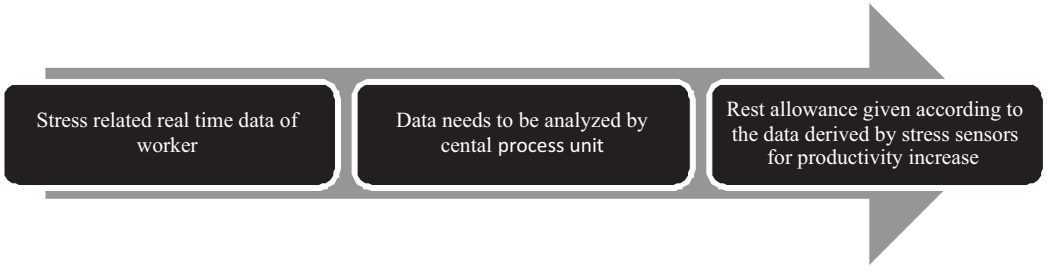
**Table 2. Comparison between Fixed time allowance and Flexible time allowance (without stress)**

| Fixed time allowance | | | | Flexible time allowance | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| With Stress | | | | With Stress | | | | | |
| **Sr no** | **Student no** | **Task completion Time (min)** | **No of faults** | **Sr no** | **Student no** | **Task completion Time (min)** | **No of faults** | **Reduction in faults** | **% reduction** |
| 1 | MBA 1 | 150 | 8 | 1 | MBA 1 | 150 | 6 | 2 | 25 |
| 2 | MBA 2 | 150 | 8 | 2 | MBA 2 | 150 | 5 | 3 | 37.5 |
| 3 | MBA 3 | 150 | 3 | 3 | MBA 3 | 150 | 2 | 1 | 33.33 |
| 4 | MBA 4 | 150 | 5 | 4 | MBA 4 | 150 | 4 | 1 | 20 |
| 5 | MBA 5 | 150 | 5 | 5 | MBA 5 | 150 | 4 | 1 | 20 |
| 6 | MBA 6 | 150 | 7 | 6 | MBA 6 | 150 | 6 | 1 | 14.29 |
| 7 | MBA 7 | 150 | 3 | 7 | MBA 7 | 150 | 1 | 2 | 66.67 |
| 8 | MBA 8 | 150 | 2 | 8 | MBA 8 | 150 | 1 | 1 | 50 |
| 9 | MBA 9 | 150 | 2 | 9 | MBA 9 | 150 | 1 | 1 | 50 |
| 10 | MBA 10 | 150 | 4 | 10 | MBA 10 | 150 | 2 | 2 | 50 |
| 11 | MBA 11 | 150 | 9 | 11 | MBA 11 | 150 | 5 | 4 | 44.44 |
| 12 | MBA 12 | 150 | 6 | 12 | MBA 12 | 150 | 4 | 2 | 33.33 |
| 13 | MBA 13 | 150 | 10 | 13 | MBA 13 | 150 | 9 | 1 | 10 |
| 14 | MBA 14 | 150 | 8 | 14 | MBA 14 | 150 | 7 | 1 | 12.5 |
| 15 | MBA 15 | 150 | 10 | 15 | MBA 15 | 150 | 5 | 5 | 50 |
| 16 | MBA 16 | 150 | 8 | 16 | MBA 16 | 150 | 7 | 1 | 12.5 |
| 17 | MBA 17 | 150 | 5 | 17 | MBA 17 | 150 | 4 | 1 | 20 |
| 18 | MBA 18 | 150 | 6 | 18 | MBA 18 | 150 | 5 | 1 | 16.67 |
| 19 | MBA 19 | 150 | 4 | 19 | MBA 19 | 150 | 3 | 1 | 25 |
| 20 | MBA 20 | 150 | 10 | 20 | MBA 20 | 150 | 3 | 7 | 70 |
| 21 | MBA 21 | 150 | 6 | 21 | MBA 21 | 150 | 3 | 3 | 50 |
| 22 | MBA 22 | 150 | 6 | 22 | MBA 22 | 150 | 5 | 1 | 16.67 |
| 23 | MBA 23 | 150 | 5 | 23 | MBA 23 | 150 | 2 | 3 | 60 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 24 | MBA 24 | 150 | 4 | 24 | MBA 24 | 150 | 3 | 1 | 25 |
| 25 | MBA 25 | 150 | 1 | 25 | MBA 25 | 150 | 1 | 0 | 0 |
| 26 | MBA 26 | 150 | 7 | 26 | MBA 26 | 150 | 8 | 1 | 14.29 |
| 27 | MBA 27 | 150 | 5 | 27 | MBA 27 | 150 | 6 | 1 | 20 |
| 28 | MBA 28 | 150 | 8 | 28 | MBA 28 | 150 | 7 | 1 | 12.5 |
| 29 | MBA 29 | 150 | 10 | 29 | MBA 29 | 150 | 8 | 2 | 20 |
| 30 | MBA 30 | 150 | 7 | 30 | MBA 30 | 150 | 3 | 4 | 57.14 |

Nearly all the subjects have shown improvement in productivity and stress handling with our framework of allowance allocation in both Fixed time allowance and Flexible time allowance (without stress) and Fixed time allowance and Flexible time allowance (with stress).

**Figure 1. Process view of stress rating based fatigue allowance allocation**




The whole process depends on the individual ability to handle stress and how can it be handled with efficient breaks at the time of starting of building up of stress, so that the worker can overcome from it easily before it creates a permanent sign of stress related attributes that results in lower efficiency and productivity.

**Discussion**

The result shows that stress directly affects the output of the work, in order to decrease the stress we have provided with judicial framing of breaks. There is a mean reduction of 25 % in the number of faults in case of flexible rest allowance in with stress scenario, while there is a mean reduction of 29 % in the number of faults in case of flexible rest allowance in without stress scenario.

The overall result shows that the stress can have drastic effect on the worker productivity in case of service sector, where the overall quality of work is seen to be directly influenced by the level of exact fatigue breaks in between. The study also reflects the improvement in the work quality and with the increase in the work pressure sensing devises working in

coordination for stress related data collection, the importance of our rest allowance framework will be increasing many folds.

**Conclusion and Future Work**

The framework decided in our study has proved very helpful in deciding the rest allowance and it needs to be further analyzed for different types of industries, primary studies on the framework have shown that the productivity is increased since in the same time span, there is a decrease of 29% in number of faults when the allowances are given according to the stress measuring method.

The result shows that the improvement in seen in both with the stress and without stress category when the flexible work breaks according to stress level are indicated. There is an overall mean reduction of 25 % in the number of faults in case of flexible rest allowance in with stress scenario, while there is an overall mean reduction of 29 % in the number of faults in case of flexible rest allowance in without stress scenario.

In the future, studies are needed to be made more accurate by better stress sensing devices interfacing and the study can also be helpful in creating a standard for each study and even the flexibility for each individual worker can be maintained in spite of having standards, which is the main advantage of our system that needs to be harnessed in future to its full capacity.

The study shows how these stress based allowance allocation can actually be helpful in providing a stress free working atmosphere to the employees and this method is more applicable in the case of service sector where conventional allowance allocation methods are very difficult to implement and hence this methodology can be very successfully implemented in service sector and when such studies will be done on a mass scale they can even be used to form and implement industry standards as a whole which can be useful in forming a benchmark for other industries of the same sector or type.

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