Chapter – 5.0  Performance based Payment System – Empirical reactions of the employees.

"The origins of today's financial crisis lie not in the mysteries of the global financial architecture but in the pay-for-performance practices." - Simon Caulkin, The Observer

Fed up with compensation plans that are fueled by an entitlement mentality, some employers are turning the tables and indexing pay to the one thing that really matters: performance.

It's no big surprise that compensation is the issue that causes the most anxiety in Indian workplaces. Employees want more of it, but it's becoming harder and harder for employers to justify raises simply on the basis of time served.

Based on my many conversations with small-business owners, I can tell you that most employers don't have a problem giving raises to their employees if the employees are doing their part to ensure business growth and profitability.

However, in many companies that's a big "if." At present, pay for performance is on the top of companies' and investors' agendas. Many organizations are suffering the problems generated by compensation systems that are out of proportion, reward inadequate performance and are not aligned with the long-term interest of the organization.

The problem is not how much money you pay your employees' performance. The problem is

- How our pay packages are designed and
- How our individual, team and corporate performance is measured and targeted.
I started my interactions with the organization by asking some key questions which were designed to pull out information that will be relevant to the designing of Strategic Performance Indicators (SPI’s), which are basically measures (quantifiable and with expressed weightages) that can be assessed for individuals / groups to evaluate their performance. The questions were aimed at getting the ‘Why, Who, What, Where, Can and When’ types of answers related to their performance on-the-job. The key questions are:

a) Is Performance Related Pay desirable in your organization (‘Why’ of measurement)?

Do you think it is a correct philosophy and will people in your organization be interested in getting a part of their incentive (extra) based on their performance? Would you be O.K. if somebody got more money than you based on clear-cut measurable performance criteria?

b) Is PRP feasible in your organization (‘can’ of measurement)?

Do you think PRP can be implemented in your organization? What major problems do you foresee in your organization? Can you overcome them? What do you think are its advantages and disadvantages in the context of your organization? Can you make PRP possible?

c) Whether PRP should be implemented in the organization at all levels or only partially (‘How’ of measurement)?

It was asked whether all levels should be included for PRP or should it be implemented only at the senior/junior level, for field deployments only / administrative sections as well.

d) Should PRP be implemented at individual level or group level (‘How’ of measurement)?
PRP can be implemented at both individual / group level. Both have its associated advantages and disadvantages. Another option is to implement it at both the levels – largely group but some notional differentiation could be created for the above-average performing individuals. Similarly, there can be a negative incentive as well, where some individuals within the group can be blocked from getting PRP.

e) **Time-job audit of 100 hours of work for a few people at different levels within the same section/unit in the organization (‘What’ of measurement).**

This question was used for developing an understanding of what jobs and its component activities are employees performing in any given 100 hours. The idea is to ask people to tabulate their 100 hours of work which will show what activities they are doing (answers the ‘what to measure’ question in a way) and which activities takes most of their time (answers the relative ‘Weightages’ attributable to different activities in any given job profile).

f) **Development of ‘Strategic Performance Indicators (SPI’s) (‘What’ of measurement) in quantifiable terms for each post/group, against which appraisal is to be done.**

This derives from the previous question where main jobs are identified, performed by employees at different levels. Those jobs can be further broken into sub-activities which have more realistic, tangible and measurable outputs that can be taken to be the criterion for measurement of performance. As far as possible, these criteria should be observable and performance against the same should be recorded regularly, which will feed into the annual performance assessment for the grant of PRP.

g) **Periodicity of review/appraisal for PRP which may vary from level to level and from post to post (‘When’ of measurement).**
Once we identify what to measure, the next question is when to measure it? Should it be measured every month, quarterly, half-yearly, or annually? It could vary by levels of hierarchy and the nature of job as it doesn’t make a lot of sense to measure the performance of the top management every month as decisions are more long-term and take time to take and implement. However, for lower level employees even a weekly assessment is possible.

h) Who should measure performance (‘Who’ of measurement)?

This is again a very critical question. Should performance for the purposes of granting PRP be assessed by the immediate boss / boss and one of his superiors / peer review / 360 degree feedback / assessment panel or board at the top level / internal and external experts / through software created for this etc.

i) Is a pilot project needed (‘Where’ of measurement)?

Once the previous questions are answered, its time to start implementing PRP. Should we discuss the relevant SPI’s with stakeholders before implementing it and ask them to vet it and then implement PRP at an organizational level? Should we involve only one unit for a pilot study, implement it there, get corrective feedback, review and improve the system and then try it there again, again get feedback and do review, and then extend it to the organization? If a pilot is required, then where would you like to implement the pilot?

j) Metrics of Implementation

It combines all the previous questions and asks the organization to assess as to how to go about implementing the pilot and / or organization-wide. Will they form a team to implement PRP / co-opt an external expert on the
team / training for the team / tenure for the team members / spectrum of experience to be represented on the team etc?

**Performance Appraisal / Rating**

A four point scale has been developed for performance appraisal depending on the level of expectations (read targets / benchmarks) met. Based on this scale employees can be granted PRP.

1. **Completely Met Expectations (CME)** – those who met 95% to 100% of the evaluation criterion. People in this group may be awarded 25% of their total Basic Pay earned during the year as PRP.

2. **Satisfactorily Met Expectations (SME)** – those who met 85% to 94.99% of the evaluation criterion. People in this group may be awarded 12.5% of their total Basic Pay earned during the year as PRP.

3. **Partially Met Expectations (PME)** - those who met 75% to 84.99% of the evaluation criterion. People in this group may be awarded 5% of their total Basic Pay earned during the year as PRP.

4. **Not Met Expectations (NME)** – those who met below 75% of the evaluation criterion. People in this group will not be eligible for PRP.

This model implies that the minimum expectations to be met are set at 75% for the organization as a whole. Employees will be expected to meet 75% of their targets every year, less than which they will not be eligible for PRP. This will over time increase the level of performance of the organization and enhance its productivity. An important advantage of this model is that theoretically the entire organization can be rewarded PRP if it achieves 75% of the performance expected from it.
5.1 Proposed base model for PRP

1. **20-30% of the total number of employees should be entitled to Performance Related Pay:** This seems to be most suited as it will cover a significant portion of the population – it is not too less and not too high. Other models of 5 – 10% or up to 70 - 80% of the population were considered but rejected. If it is too low say 5%, it becomes almost unachievable for most of the people who consider themselves to be average or above average performers (but not exceptional), and does not create strong enough incentives for most of the people to attract them to try and perform better in order to get PRP. If it is too high say 80%, then it becomes like an allowance or an automatic payment and most of the people start taking it for granted, which is not the ethos behind introducing PRP. In this case as well, it does not create a strong enough incentive for people to exert themselves in order to improve performance. Thus, we feel 20 – 30% is an optimum figure to let people feel that they can qualify in this range, and will act as an incentive to improve performance.

2. **20 – 30% of annual Basic Salary should be given as Performance Related Pay to qualifying employees:** Any figure which is too small will not be motivating for people, thus 20 – 30% seems to be a reasonable figure for grant as PRP. A very high payout to a limited number of people may cause a lot of heartburn in the system.

3. **PRP should be group based:** Almost all the organizations recommended a group based implementation of PRP as they felt that performance is a team effort and individual contribution is very difficult to assess and measure.
A combination of individual and group PRP can also be introduced. Under this, apart from the whole group getting 20 – 30% as PRP, 2 – 3% of individuals among the same group can be given 3 – 5% ‘extra’ PRP for their exceptional performance within the group. At the same time, a negative provision can also be introduced to bar defaulters and trouble-makers within the same group entitled for PRP.

4. **Assessment and Award of PRP:** Organizations need to evolve mechanisms for assessment and reward of PRP. Two models are possible – first where the boss and his senior assess performance of the whole unit and reach a total score, which can then be compared against the scores of other units and finally the selected units (20-30% of the total units) can be awarded PRP. The second model is that the organization can create an Assessment Panel or Board for assessing performance against pre-set goals and benchmarks which can finally decide about granting PRP. An internal mechanism can pre-select potential units for award of PRP and present their case to the Board. This can Board can largely have internal members, as well as one of the two external members to ensure bias-free selection and more importantly to ensure that is perceived as bias-free.

5. **Periodicity of Assessment / Evaluation:** Lower level employees could be assessed every month, middle level managers could be assessed every six months and senior people can be assessed annually.

5.2 **Suggestions for the Implementation of the model**

This model should be preceded by the development of detailed, clear and measurable SPI’s for all levels and positions in the organization. As organizations have job description for every level, there should be SPI’s for every level. Different contexts must be differentiated in SPI’s so that
comparability is maintained, and to avoid comparing apples with pears. After the SPI’s are created, mutually agreeable goals must be set for each unit and certain benchmarks should be established against which performance will be measured.

Once this is in place, a team of internal people must be created who must be involved with the process from the scratch. The organization must guarantee them stability of tenure so that they remain sure and committed to the task of PRP implementation. These people must be bright officers who are enthusiastic about the idea and who have the right exposure and aptitude to implement it. They must also bring together a range of experiences and be truly representative of the organization. They must also be trained, if required. They must be made responsible for its implementation and should be given adequate authority and optimum resources for the purpose. The team can also co-opt external experts if it deems necessary.

It should be first implemented as a pilot project in some unit of the organization, preferably a unit that was also involved in the creation of SPI’s. The pilot must go on for at least six months and optimally for a year so that one whole cycle of annual activities is complete. The whole process of PRP implementation should be reviewed and feedback must be collected from all the stakeholders. The SPI’s, goals and benchmarks should be revisited to incorporate feedback and review. The revised SPI’s must be vetted by all the stakeholders in the organization and the new set must again be implemented as a pilot for six months. The same review and feedback process must be repeated and the changes incorporated. Now it can be extended to the entire organization. Two deviations are possible – some organizations can extend the second step to one year instead of six months so that the total time spent on the pilot project is two years instead of one and a half years; the other is that the organization can do a pilot only for a year and then extend it organization-wide at the
start of the second year. Both options are open and will depend on how comfortable and confident the organization feels with its experience of implementing PRP at the pilot stage.

5.3 Strength of this model

I. The biggest strength of this model lies in the model lies in its evolution. It has emerged after numerous interactions with different people at all hierarchies in different organizations.

II. The model is group based which implies that everybody within the assessed group is eligible for PRP. This does not cause interpersonal problems or heartburns within the group.

III. The model also provides for identifying and rewarding (extra) exceptional individual performance within the group.

IV. Being group based it will promote team work and strengthen the cohesiveness which is highly desirable in the context of the forces. Peer pressure will enhance the quality of work and check deviations.

V. The model provides optimum coverage in terms of the number of people and the quantum of incentives being offered as PRP. It ensures that PRP is viewed as an incentive for performance (not an allowance) and is motivating for employees.

VI. The model provides for assessment by a group of people (Assessment Board) which will minimize subjectivity and bias which can come-in if the assessment is solely in the hands of an individual.

VII. It provides for a pilot study which will give the organization an opportunity to test the model before actually implementing it.

VIII. The model has in-built flexibility where an organization can choose and adapt the model to their specific circumstances and contexts.
5.4 Limitations of this model

I. The model does not elaborate on the prospects for individual level assessment for PRP.

II. There is no one-best-way for the creation of SPI’s and benchmarking and the model leaves this critical aspect to the interpretation of the organization. However, this is a practical constraint as organizations differ in their processes, structures, resources and contexts and no single model can effectively serve the purpose for all.

The above model is found relevant and befitting only in certain circumstances – where output is clearly and tangibly measurable, and the contribution at every level can be specifically discerned and calculated.

Tamboli Castings Limited

TCL already has an old existing incentive scheme which was limited to production shop employees. A new incentive scheme needs to be devised to take care of the limitations of the old schemed and to make it more inclusive (right to the top management level). This can be a good model for implementing PRP in TCL. The details of both the schemes are discussed below:

The employees have fixed salaries that have no co-relation with the output except in the case of piecemeal workers. This group, in absence of direct linkages between salaries and performance is unable to create an inherent driving force even though it is has the longest association,
highest involvement and maximum knowledge regarding the ways and means to improve the performance of the organization. This group can have highest stakes in the organization if the performance and rewards are linked to achieve goal congruence between the organization and individual employees.

There is an over due need for providing an incentive scheme which embrace all employees of TCL. This motive can be achieved through the introduction of PRP.

5.5 Performance Pay and Productivity

Much of the theory in personnel economics relates to effects of monetary incentives on output, but the theory was untested because appropriate data were unavailable. A new data set for Tamboli Castings Limited (TCL) tests the predictions that average productivity will rise, the firm will attract a more able workforce, and variance in output across individuals at the firm will rise when it shifts to piece rates. At TCL, productivity effects amount to a 36-percent increase in output per worker. This firm apparently had selected a suboptimal compensation system, as profits also increased with the change.

During the year 2006 and 2007, after the introduction of new management, the company gradually changed the compensation method for its workforce, moving them from hourly wages to piece-rate pay. The effects, which are documented, by examining the behavior of about 90 different workers over a 12-month period, are dramatic and completely in line with economic theory. In what follows, the theory of piece-rate compensation is sketched with particular emphasis on the predictions that pertain to changes in the compensation method used by I&PCL and TCL. The theory is backed up by the empirical results, the most important of which are:
1. A switch to piece-rate pay has a significant effect on average levels of output per worker. This is in the range of a 36-percent gain.

2. The gain can be split into two components. About half of the increase in productivity results from the average worker producing more because of incentive effects. Some of the increase results from an ability to hire the most productive workers and possibly from a reduction in quits among the highest output workers. None reflects the "Hawthorne effect."

   (The Hawthorne effect, named after the Hawthorne Western Electric Plant in Illinois, alleges that any change is likely to bring about short-term gains in productivity.)

3. The firm shares the gains in productivity with its workforce. A given worker receives an average of 5-percent increase in pay as a result of the switch to piece rates.

4. Moving to piece-rate pay increases the variance in output. More ambitious workers have less incentive to differentiate themselves when hourly wages are paid than when piece-rate pay is used.

The evidence implies that the choice of compensation method has important incentive effects, not that piece-rate schemes are more profitable. In equilibrium, firms choose a compensation method based on the costs and benefits of the various schemes. Firms that continue to pay hourly wages in equilibrium are those for which the benefits of paying an hourly wage, such as low monitoring costs and perhaps higher quality output, outweigh the costs in the form of lower output. Some conclusions are unambiguous. Workers respond to prices just as economic theory predicts. Claims by sociologists and others that monetizing incentives may actually reduce output are unambiguously refuted by the data. Not only do the effects back up economic predictions, but the effects are extremely large and precisely in line with theory.
Compensation, which reflects the most important price that a consumer faces, truly matters to the workers in this setting, and they respond accordingly.

I. Modeling Choice of Pay Scheme: Hourly Wages Versus Piece Rates

The primary motivation behind instituting a piece-rate scheme is to increase worker effort. While it may seem obvious that moving from hourly wages to piece rates would increase effort, it is not. When a firm institutes an hourly wage schedule, it usually couples the payment with some minimum level of output that is acceptable. It is possible, therefore, that the minimum acceptable output chosen for hourly wage workers exceeds the level of output that workers voluntarily choose under a piece rate. Further, it may be that the minimum level chosen under hourly wages is so high that only the most able workers can make the cut. When piece rates are instituted, more heterogeneity might be tolerated, resulting in lower average levels of output. This suggests that the term “performance pay” is not very useful. Even if we restrict performance pay to refer to pay based on output (rather than input), a broad set of compensation schemes are included. Hourly wages that are coupled with some minimum standard could be called performance pay because an output based performance standard must be met to retain employment. In fact, were workers homogeneous, an hourly wage structure with a minimum number of units tolerated per hour could achieve the efficient outcome!

The conditions of the job determine which workers choose to accept employment. If standards are too strict, only the most able will find the job suitable, even at a high wage. A rough sketch of a framework that permits an analysis of the choice of standards and ability is given here.

Define $e$ to be the output level chosen by a worker, which is a function of underlying ability, $A$, and of effort choice. Suppose that the firm can observe $e$. 
The firm that pays an hourly wage can specify some minimally acceptable level of output per hour $e_0$. The firm fires workers whose output falls consistently below $e_0$. Commensurate with that level of required output is some wage, $W$, that the firm offers.

The worker’s utility function is given by:

1. $\text{Utility} = U(Y, X)$

where $Y$ is income and $X$ is effort. Naturally, $U_1 > 0$ and $U_2 < 0$.

Let $A$ denote ability. Then output, $e$, depends on ability and effort according to

2. $e = f(X, A)$

with $f_1, f_2 > 0$. For any given required level of output $e$, and ability level, $A$, there is a unique level of effort $X$ that satisfies (2). Denote by $X_0(A)$ the level of effort necessary to satisfy

3. $e_0 = f(X_0(A), A)$

for the required level of effort $e_0$. It is clear that given (2),

$$\frac{\partial X}{\partial A} = \frac{f_2}{f_1}$$

(\(\partial\) - The symbol for partial derivative of a function)

which is negative. Higher-ability individuals need exert less effort to achieve a given level of output.
For any given pair of required output and wage, \((e_0, W)\), there is a group of workers who will accept the job. The minimum-ability individual who will accept a job in lieu of leisure that requires \(e_0\) of output to be produced is \(A_0\) such that

4. \[ U(W, X_0(A_0)) = U(0, 0) \]

where \(U(0, 0)\) is interpreted as the utility associated with leisure.

All workers with ability levels that exceed \(A_0\) earn rents from employment because they are required only to produce \(e_0\) of output, and the pain associated with producing it is lower than the pain for individuals with ability \(A_0\), who are just indifferent between working and not. However, because there is competition from other firms, a worker must compare the rents earned at this firm with those offered elsewhere. Those willing to work at the firm must not have work alternatives that are preferred to those here. The utility that a worker of ability \(A\) can get at another firm that does not necessarily pay workers of all types the same amount is given by

\[ U(W^*(A), X^*(A)) \]

where \(W, X\) refer to the wage and effort levels on the best alternative job for worker of ability \(A\). Higher-ability workers are likely to find that the straight hourly wage job is not as attractive as an alternative that demands more, but pays more, even if the less able workers would find such a job onerous. Thus, there may exist an upper cutoff, \(A_h\), such that

5. \[ U(W, X_0(A_h)) = U(W^*(A_h), X^*(A_h)). \]

Those who choose to work at the current firm have ability greater than \(A_0\), but less than \(A_h\).

A linear piece rate takes the form \((be - K)\) where \(K\) is the implicit charge for the job. The utility that a risk-neutral worker receives can be written
Utility under piece rate $= U(bf(X^*(A), A) - K, X^*(A))$

Where $X^*(A)$ is the effort that an individual with ability $A$ chooses when faced with the piece rate $b$.

In order to fit the TCL situation analyzed in the empirical section below, it is useful to model the effects of switching from an hourly wage with minimum standard to a piece rate with a minimum guarantee. As part of their plan, it offered a guarantee at approximately the former wage. The guarantee was coupled, presumably, with the same minimum standard of $e_0$ as before. Thus, the plan paid $W$ to anyone who would have earned less than $W$ under the piece rate, but paid the piece rate to all of those whose compensation by the piece-rate formula would have exceeded $W$. The scheme used is

Compensation $= \max [W, be - K]$.

The situation is shown in Figure 5.1.
This scheme is typical of many salespersons’ plans. A draw, in this case equal to $W$, is paid to workers whose output exceeds $e_0$ up to some level of output, $e^*$. At output greater than $e^*$, the worker begins to receive additional compensation for increases in output. As long as the worker produces $e > e^*$, his compensation is given by $be - K$. At most firms, workers who continually dip into their draw by producing $e < e^*$ are likely to find their employment terminated after some period of time.

Low-ability workers have steep indifference curves because additional effort must be compensated by large increases in income. The solid indifference curve through $A$ is that of a relatively low-ability worker. The dotted indifference curve through $A$ reflects the preferences of a higher-ability worker since it takes less income to induce him to provide a given amount of effort. (“Ability” can be read “ambition” in the interpretation of $A$. Nothing is changed.)

The hourly wage schedule is shown by the step function that starts at zero, becomes vertical at $e_0$ and then horizontal at point $A$. The piece-rate schedule with guarantee is the same, except that compensation rises with output above $e^*$, as shown by the upward-sloping segment. When workers are offered hourly wages, all, even the most able, choose point $A$. When offered the piece-rate schedule with a guarantee, the less able worker (solid) still chooses $A$, but the more able worker (dotted) chooses $B$. This can be stated more formally in three propositions, which are proved in the Appendix.

**PROPOSITION 1:**

Effort does not decrease when the firm switches from hourly wages to piece rates, and as long as there is some ability type for which output rises, average effort increases.
Because the guarantee binds for some workers, but not for all, effort does not increase for all workers. Workers whose optimal level of effort lies to the left of $e^*$ in Figure 5.1 gain nothing by increasing effort. But those whose optimal level of effort is sufficiently high may choose to work enough to be on the upward sloping portion of the compensation function.

Another proposition can be stated, given two conditions:

*Condition 1*: If a worker with ability $A$ chooses to work at an effort level in the piece-rate range, then any worker with ability greater than $A$ also chooses to work at an effort level in the piece rate range.

*Condition 2*: If a worker with ability $A$ chooses to work at an effort level in the wage-guarantee range, then any worker with ability less than $A$ also chooses to work at an effort level in the wage-guarantee range.

Then,

**PROPOSITION 2:**

A sufficient condition for the average ability of the workforce to be non-decreasing, and more generally, to rise after the switch to piece rates is that some workers accept the guaranteed wage and some workers choose to work enough to be in the piece-rate range.

Average ability rises because the ability of the lowest-quality worker does not change as a result of the switch in compensation scheme, but the ability of the highest-quality worker rises. Because a piece rate allows the more able to work harder and receive more from the job, and because the hourly wage does not, more able workers prefer piece rates. The least-able worker is indifferent between the two schemes. Switching to piece rates has the effect of changing
the pool of applicants to TCL. Those who prefer to work at high levels of effort favor TCL over other firms in the industry after the switch.

Finally,

**PROPOSITION 3:**

A sufficient condition for the range of worker ability and output to rise after the switch to piece rates is that some workers choose to work enough to be in the piece-rate range.

Even if underlying ability levels did not change, variance in productivity would rise because workers choose the same level of output under an hourly wage, but type-specific levels of output under piece rates. When it is recognized that the maximum ability level increases under a piece rate, the change in output variance becomes even greater.

(The condition that some workers continue to opt for the guaranteed wage is not superfluous. If all workers opt for the piece rate, then it is possible that even very low ability workers who did not work before now work for the firm. Their addition could actually result in a lowering of average ability.)

**II. Data**

In 2006, TCL, under the guidance of DIRECTOR - Mehul B. Tamboli implemented a new compensation scheme for the **Wax Pattern Shop**. Until January 2006, workmen were paid an hourly wage rate at I &PCL, which did not vary in any direct way with the number of assemblies. During 2006 and 2007, workmen were shifted from an hourly wage schedule to performance pay—specifically, to a piece-rate schedule. Rather than being paid for the number of hours that they worked, workmen were paid for the number of wax patterns that they produced. The rates varied somewhat. On average, workmen were paid about Rs. 20 per wax pattern / assembly formed. At the time that the piece rates
were instituted, the workers were also given a guarantee of approximately Rs. 11 per hour. If their monthly pay came out to less than the guarantee, they would be paid the guaranteed amount. Many workers ended up in the guarantee range.

M. B. Tamboli changed the compensation scheme because he felt that productivity was below where it should have been. Productivity could have been raised by requiring a higher minimum level of output under a time rate system. If all workers had identical preferences, this would have worked well.

Given differences in work preferences, a uniform increase in required output, coupled with a wage increase, would not be received in the same way by all workmen. In particular, the lower-output workmen would find this more burdensome than the higher-output workmen. In order to avoid massive turnover, TCL adopted a piece-rate schedule, which allowed those who wanted to work more to earn more, but also allowed those who would accept lower pay to put forth less effort.

TCL has a very sophisticated computerized information system, which keeps track of how many units of each kind each workmen in the Wax pattern shop produce in a given week. TCL provided monthly data. Since PPP (Performance Pay Plan) was phased in over a 12-month period, many workers were employed under both regimes. Thus, data on individual output are available for most workmen both during the hourly wage period and during the PPP period. This before-and-after comparison with person specific data provides a very clean body of information on which to base an analysis of performance pay incentives.

Some basic characteristics of the sample are reported in Table 1. The data are organized as follows. Each month provides an independent unit of observation. There are 927 person months of data covering a 12-month period. Over the 12-month period, there were a total of 90 different individuals who worked for TCL.
as workmen. The number of “good” observations is 549 when partial months and observations with incomplete data are dropped from the data set.

There are a number of possible productivity measures. The one that most TCL managers look to is units-per-worker-per-day. This is the total number of wax pattern assembly units per eight-hour day that are produced by a given workman. The units-per-worker-per-day number for each individual observation relates to a given worker in a given month. Thus, units-per-worker-per-day is the average number of units per eight-hour period produced by the given worker during the given month.

The average number of wax patterns produced per day over the entire period is 2.98, with a standard deviation of 1.53. The average actual pay was Rs. 2,254,
which is above the amount that would be paid had the worker received exactly the amount to which he was entitled based on a straight piece rate. The difference reflects vacation, holiday, and sick pay, as well as two other factors. First, not all workers are on PPP during the period. When on hourly wages, some received higher compensation than they would have had they been on PPP, given the number of units produced. Of course, when a given worker switches to PPP, incentives change and his output may go up enough to cover the deficit.

Second, even when workers are on PPP, a substantial fraction of person-months calculated on the basis of the PPP formula comes in below the guaranteed monthly compensation. The guarantee binds for those worker months, and actual pay then exceeds PPP pay. In all months after the introduction of PPP, at least some workers received the guaranteed pay and some earned more than the guarantee. Thus, the sufficient conditions for Propositions 2 and 3 are met throughout the period.

<table>
<thead>
<tr>
<th>TABLE 2 - Mean and Standard Deviations of Key Variables by Pay Structure</th>
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<tbody>
<tr>
<td><strong>Variable</strong></td>
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<tr>
<td>Number of observations</td>
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<tr>
<td>Units-per-worker-per-day</td>
</tr>
<tr>
<td>Actual pay</td>
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<tr>
<td>PPP pay</td>
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<td>Cost-per-unit</td>
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Note: 148 observations were dropped because the individual spent part of the month on PPP and part on hourly wages.

Means for actual and PPP pay reveal almost nothing about the effects of PPP on performance and sorting. A more direct approach is needed. Table 2 presents some means of the key variables and breaks them down by the PPP dummy, which is set equal to one if the worker in question is on PPP during the given month. (Only observations where workers were on one pay regime or the other for the full month are used. Partial month observations are deleted.)
The account that will be told in more detail below shows up in the simple means. The average level of units-per-worker-per-day is about 0.54 units, or 20 percent higher in the piece-rate regime than in the hourly wage regime. Also, the variance in output goes up when switching from hourly wages to piece rates, as can be seen by comparing the standard deviations of 1.59 to 1.42.

Thus, Propositions 1, 2, and 3, which state that both mean and variance in output rise when switching from hourly wages to piece rates, are borne out by the simple statistics. Further, note that there is good indication that profitability went up significantly with the switch. The cost per unit is considerably lower in the piece-rate regime than it is with hourly wages.

The simple statistics do not take other factors into account. In particular, demand in existing market and the changing world economic conditions. Month effects and year effects matter. Perhaps more important, the management change that took place before PPP was instituted had other direct effects on the company that may have changed output during the sample period, irrespective of the switch to PPP. To deal with these factors, month and year dummies are included. The simplest specification in the first row of Table 3 yields a coefficient on the PPP dummy of 0.368. Evaluated at the mean of the log of units-per-worker-per-day, this coefficient implies that there is a 44-percent gain in productivity with a move to PPP.
There are three possible interpretations of this extremely large and statistically precise effect.

First, the gain in productivity may result from incentive effects associated with the program.

Second, the gain may result from sorting. A different group of workers may be present after the switch to piece rates.

Third, the pattern of implementation may cause a spurious positive effect. Suppose that TCL picked its best workers to put on piece rates first. The PPP dummy coefficient would pick up an ability effect because high-ability workers would have more PPP months than low-ability workers. Unless ability is correlated with region in a particular way, the third explanation can be ruled out because TCL switch its stores to PPP on a regional basis, starting with Nari Road, where the headquarters is located, and moving out to Vartej.

The other two effects can all be identified by using the data in a variety of ways. When worker dummies are included in the regression, the coefficient drops to
0.197 from 0.368. The 0.197 is the pure incentive effect that results from switching from hourly wages to piece rates. Evaluated at the means, it implies that a given worker produces 22 percent more units after the switch to PPP than he did before the switch to PPP. This estimate controls for month and year effects.

Individual ability is held constant as is shop location by including the person dummies. Approximately half of the 36-percent difference in productivity attributed to the PPP program reflects an incentive effect. Nor does this gain appear to be a Hawthorne effect.

This can be seen by examining regression 3 in Table 3. The regression includes a variable for tenure and also one for time that the worker has been on the PPP program. It is zero for all months before the individual is on piece rates. It is the number of years that the individual has been on piece rates in the current person-month observation.

For example, a worker who started 2006 on hourly wages and was switched to PPP on July 1, 2006 would have time since PPP equal to zero for the June 2006 observation, to 0.5 for the January 2007 observations, and to 1.0 for the June 2007 observation. Consider the estimates with fixed effects in regression 4. The coefficient of 0.273 on time since tenure coupled with a PPP dummy coefficient of 0.202, means that the initial effect of switching from hourly wage to piece rate is to increase log productivity by 0.202.

After one year on the program, the increase in log productivity has grown to 0.475. The Hawthorne effect would imply a negative coefficient on time since PPP. If the Hawthorne effect held, then the longer the worker were on the program, the smaller would be the effect of piece rates on productivity. The reverse happens here. After workers are switched to piece rates, they seem to learn ways to work faster or harder as time progresses.
III. Sorting

Tenure effects are large and significant. Using regression 3 of Table 3, it is estimated that one year of tenure raises log productivity by about 0.34. As is true of all tenure estimates, there are two interpretations. The first is learning. Turnover rates are over 4 1/2 percent per month, and the mean level of tenure is only about two-thirds of a year. It would not be surprising to see a worker increase his wax pattern production rate dramatically during the first few months on the job. The second interpretation is one of sorting. Those who are not making it get fired or quit early. Regression 4 of the table assists in interpretation.

Regression 4 reports the estimates of the regression in regression 3, including fixed effects for individuals. Thus, the tenure coefficient reflects the effect of tenure for a given worker, averaged across individuals. The estimate of 0.20 on log productivity can be interpreted as the average effect of learning within the sample.

Thus, the effect of learning appears substantial. The theory stated in Propositions 2 and 3 suggests that the optimal piece rate is implemented such that both mean and range of worker ability should rise after the switch to piece rates. The theory implies specifically that there should be no change in the number of low-ability workers who are willing to work with the firm, but that piece rates would allow high-ability workers to use their talents more lucratively. Thus, the top tail of the distribution should thicken. Underlying ability is difficult to measure, but actual output can be observed. The fifth regression of Table 3 provides evidence on this point. “New regime” is a dummy set equal to one if the individual was hired after January 1, 2007, by which point almost the entire firm had switched to piecework. The theory predicts that workers hired under the new regime should produce more output than the previously hired employees. (Taken literally, the theory implies that none of the low-output incumbents should leave since the guarantee
makes them no worse off than before, but some higher quality workers are now willing to take the job.)

Indeed, workers hired under the new regime have log productivity that is 0.24 greater than those hired under the old regime, given tenure. Separations can also be examined. Suppose that workers must try the job for a while to discover their ability levels. Workers who find the job unsuitable leave. Then, looking at the relation of ability to separation rates (quits plus layoffs) before and after the switch to piece rates will provide evidence on the validity of Propositions 2 and 3.

A separation is defined as an observation in which the worker in question did not work during the subsequent month. Thus, a dummy is set equal to one in the last month of employment. Those workers who work through July 2007 (the last month for which data are available) have this dummy set equal to zero for every month in which they worked. A worker who was employed, say from July 2006 through February 2007, would have the dummy equal to zero in every month of employment, except for February 2007, when it would equal one.

Table 4 reports a breakdown of separation rates by PPP regime and by worker output deciles where output is defined as units-perworker-per-day during the previous month.
First note that simple effect of a move to PPP increases turnover from 3.3 percent per month to 3.6 percent per month, but the difference is not statistically significant. (Note that the turnover rates in Table 4 are lower than the one reported in Table 1. This is because in order to be in the sample for Table 4, the worker must have been with the firm during the previous month as well. Thus, those who leave during their first month are included in Table 1 but not in Table 4.)

The direction of the change is not surprising since a major change in the pay system may make some of the incumbents unhappy enough to leave or may signal that the firm has become less tolerant of low productivity.

Second, theory predicts that those at the higher end of the ability spectrum should see turnover rates that decline. Although the highest output declines are the ones that experience the largest declines in separation rates, the differences are not statistically significant.
IV. Fixed Effects

Some of the theoretical predictions can be tested by estimating person-specific fixed effects. Since the data set consists of multiple observations on a given individual over time and under different regimes, person-specific effects can be estimated. Fixed effects are estimated from a regression of the log of output-per-worker-per-day on tenure and time dummies.

Should this be done using data from both regimes combined or from one or the other? Some workers were employed in both hourly wage and piece-rate regimes whereas some worked in only one regime. The theory implies that incentives are muted during the hourly wage period, so it is not clear that fixed effects based on output during the hourly wage period are good proxies for ability. This might suggest using the fixed effects estimated during the piece-rate regime for those who worked in both regimes. But then separation behavior over the two regimes cannot be examined since no one who worked in both hourly wage and piece-rate regimes left the firm during the hourly wage regime.

An alternative is to use the hourly wage regime estimated fixed effects, based on the argument that fixed effects are highly correlated across periods. Indeed, there is evidence of strong correlation. Figure 5.2 shows the scatter plot, which reveals the pattern. The correlation between the fixed effect from the hourly wage period and that from the piece-rate period is 0.72 with 119 observations. This correlation is high, but not perfect. There are some workers who performed relatively better under the hourly wage system than under the piece-rate system and vice versa. A regression of the fixed effect from the piece-rate regime on the same individual’s fixed effect from the hourly wage regime yields a coefficient of 0.700 with a standard error of 0.017. The constant term is 20.04 with a standard error of 0.01. The effect of ability on effort is attenuated during the hourly wage period because there is less incentive to put forth effort. If the fixed effect of output in the piece-rate period measures true ability, whereas the fixed effect
during the hourly wage period measures ability only imperfectly, then the coefficient in the regression of piece-rate fixed effects on hourly wage fixed effects is biased toward zero. (The bias is caused by the standard errors-in-variables problem, where the observed independent variable is not the true effect, but instead the true effect plus measurement error). The fact that it equals 0.700 suggests that workers do reveal their abilities to a large extent even during the hourly wage period. (The relation of ability to output need not be monotonic, especially during the hourly wage period. Since the lowest-and the highest-ability workers earn rents and may therefore put forth additional effort to reduce the likelihood of a termination).

This evidence provides a rationale for using the hourly wage-period fixed effects to examine turnover. The median level of fixed effect for those who leave no later than two months after the start of the piece-rate system (the leavers) is 0.15 with an upper bound of the 95-percent confidence interval of 0.19. The median level of fixed effect for those who stay beyond the initial two months (the stayers) is 0.22 with a standard error of lower bound of the 95-percent confidence interval at 0.21. The medians are significantly different, with the more able, as measured by pre-period fixed effects, being more likely to stay. (Part of this difference may reflect pure selection that would occur even in the absence of a regime change.
Presumably, the tenure variable included in the output regression controls for most of the regime-independent sorting.)

There is no evidence that the stayers have higher variance in ability than the leavers. The standard deviation of the fixed effects for the stayers is 0.68 and that for the leavers is 0.89, with number of observations equaling 1,511 and 659, respectively. More evidence on this point is presented in Table 5, where fixed effects estimated on hourly wage-regime data are computed for those individuals who worked in both regimes.

Again, the results of Table 5 suggest that the prediction about variance in ability finds no support in the fixed effects results. (The difference between this sample and the previous one is that the former sample included those who left before piece-rate-based fixed effects could be estimated).

The standard deviation in fixed effects among piece-rate workers is virtually identical during the piece-rate and hourly wage regime. The 90-10 percentile is higher during the hourly wage regime. Although Table 2 reveals an increase in the variance in output when the firm switches from hourly wages to piecework, the increase in variance does not reflect an obvious change in the dispersion of underlying ability.

<table>
<thead>
<tr>
<th>Regime</th>
<th>Number of individuals</th>
<th>Standard deviation in fixed effects</th>
<th>Difference between 90th and 10th percentile in fixed effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hourly wage</td>
<td>119</td>
<td>0.65</td>
<td>1.28</td>
</tr>
<tr>
<td>Piece rate</td>
<td>119</td>
<td>0.64</td>
<td>1.12</td>
</tr>
</tbody>
</table>

Table 5—Variation in Fixed Effects
Summarizing, it is clear that person-specific effects are important. They play a significant role in the interpretation of the results of Table 3, and their pattern is consistent with the theory in that their mean levels tend to rise as the firm goes from time rates to piece rates. They provide no support for the hypothesis that variance in underlying ability increases when the firm switches from time rates to piece rates. Ability is higher among those who work at the end of the sample period than among workers present at the beginning of the sample period. Most of the increase in ability is a result of selection through the hiring process that occurs after piece rates are adopted.

The effect of differential changes in turnover rates, hiring policy, and incentives can be summarized by the kernel densities of output shown in Figure 5.3. The two distributions look rather similar, but it is clear that the piece-rate distribution lies to the right of the hourly wage distribution.

Further, the peak value of the density function during the piecework regime is lower than that of the hourly wage regime. There is less concentration of output around the modal value under piece rates than there is under hourly wages.
V. Pay and Profitability

The effect of the program on pay can be traced also. Table 6 reports the effects of the switch to the PPP regime. The log of pay-per-worker went up by 0.068, implying about a 7-percent increase in compensation. Recall that the increase in productivity for the firm as a whole was 36 percent.

Regression 2 of Table 6 implies that the log of pay for a given worker rose by 0.099, implying a 10.6-percent gain in earnings. This is just under half the increase in per-worker productivity. Thus, the firm passes along some of the benefits of the gain in productivity to its existing workforce. The effect without worker dummies is smaller than that with worker dummies because the newer workers are paid less than the more senior workers whom they replace. Further, 92 percent of workers experienced a pay increase, with a quarter of the workers receiving increases at least as large as 28 percent. Did profits rise? This depends on the increase in productivity relative to the increase in labor and other costs. Given the numbers (28-percent increase in productivity, 7-percent increase in wages), it is unlikely that other variable costs of production ate up the

<table>
<thead>
<tr>
<th>Regression number</th>
<th>PPP dummy</th>
<th>$R^2$</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.068</td>
<td>0.06</td>
<td>Dummies for month and year included</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.099</td>
<td>0.76</td>
<td>Dummies for month and year; worker-specific dummies included (2,755 individual workers)</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Standard errors are reported in parentheses below the coefficients.
Dependent variable: In pay-per-day.
Number of observations: 29,837.
margin still given to the firm. The piece-rate plan seems to have been implemented in a way that likely made both capital and labor better off.

There is one cost that has been ignored throughout. Piecework requires measurement of output. In TCL's case, the measurement comes about through a very sophisticated information system. But the system involves people and machines that are costly. Indeed, in equilibrium, firms that pay hourly wages or monthly salaries are probably those for whom measurement costs exceed the benefits from switching to output-based pay. In this case, the gains in productivity were very large. Further, the information systems were initially put in place for reasons other than monitoring worker productivity, having to do with inventory control and reduced production lags. The economies of scope in information technology, coupled with the labor productivity gains, are probably large enough to cover whatever additional cost of monitoring was involved.

VI. Quality

One defect of paying piece rates is that quality may suffer. In the TCL case, most quality problems show up rather quickly in the form of broken assemblies. Since the broken assembly can be easily identified, there is an efficient solution to the quality problem.

VII. Piecework Is Not Always Profitable

It is interesting that the productivity gains are so large for this particular firm. Of course, this is only one data point and it is one where the case for piece rates seems especially strong. Output is easily measured, quality problems are readily detected, and blame is assignable.

Managerial and professional jobs may not be as well suited to piecework. The fact that the productivity gains are so large in this case is worthy of attention, but
these results do not imply that all firms should switch to piece-rate pay. The use of incentive pay, broadly defined, is more widespread. Pencavel (1978 p. 228, Table 2) reports a peak of 30 percent of workers in manufacturing who received incentive pay in the United States in 1945–1946, with a downward trend afterward.

The relative paucity of piece-rate pay in the United States is not particularly disturbing for this study. For one thing, piece rates remain more prevalent in other countries. For example, using a data set on manufacturing in Sweden (which accounts for 20 percent of the workforce), it is found that 22 percent of workers received piece-rate pay as late as 1990. But even were this not the case, the experiment would be relevant. As far as the workers are concerned, the effect of a change in compensation was exogenous, and the data consist of about 3,000 independent worker responses to that common change. The implication of the study is not that firms should switch to piecework, but rather that when workers faced a new compensation scheme, they responded by altering effort, turnover, and labor-supply behavior in the way predicted by theory.

VIII. Summary and Conclusion

The results imply that productivity effects associated with the switch from hourly wages to piece rates are quite large. The theory implies that a switch should bring about an increase in average levels of output and in its variance. These predictions are borne out. The theory does not imply that profits must rise.

Market equilibrium is characterized by firms that choose a variety of compensation methods. Firms choose the compensation scheme by comparing the costs and benefits of each scheme. The benefit is a productivity gain. Costs may be associated with measurement difficulties, undesirable risk transfers, or quality declines.
The theory above implies that average output per worker and average worker ability should rise when a firm switches from hourly wages to piece rates. The minimum level of ability does not change, but more able workers, who shunned the firm under hourly wages, are attracted by piece rates. As a result of incentive effects, average output per worker rises. Thus, average ability and output, as well as variance in output and range of ability, should rise when a firm switches from hourly wages to piece rates.

The effects of changing the compensation method were estimated using worker-level monthly output data from Tamboli Castings Limited. The primary predictions of the theory are borne out. Moving to a piece-rate regime is associated with a 36-percent increase in productivity for the company as a whole. Part of the gain reflects sorting, part reflects incentives, and some may reflect the pattern in which the scheme was implemented. The incentive effect of the piece-rate scheme accounts for an increase in productivity of about 22 percent. The rest of the 36-percent increase in productivity is a result of sorting toward more able workers or possibly some other factors. Sorting occurs primarily through the hiring process, where a disproportionate share of newly hired comes from higher ability groups after the switch to piece rates. There is no strong evidence that the change to piece rates increases separations relatively more among lower-output workers. Nor is there evidence of an increase in range or variance in underlying ability after the switch to piecework.

Since the data measure actual productivity, tenure effects on productivity (rather than wages) can be estimated. Tenure effects on productivity are found to be large. Part reflects learning on the job, but a significant fraction reflects sorting that induces the least productive workers to leave first. Also, time since the introduction of the piecework scheme is positively associated with productivity. Workers captured some of the return from moving to piece rates. The average incumbent worker’s wages rose by just over 10 percent as a result of the switch.
Over 90 percent of the workers had higher pay during the piece-rate period than they did during the hourly wage period.

APPENDIX

PROOF OF PROPOSITION 1:
Output cannot fall below e0 because of the firm-imposed constraint at e0. But output may exceed e0 if for some A, \( A_0 \leq A \leq A_h \),

(A1) \[ U(W, X_0(A)) < U(bf(X^*(A), A) - K, X^*(A)) \]

where \( X^*(A) \) is the effort level chosen by worker of type A given piece rate b. As long as there is some type A for whom output rises, average output must rise.

PROOF OF PROPOSITION 2:
If any choose to work in the piece-rate range, then surely the worker with the highest ability chooses to work in this range. But the highest ability worker cannot, except in the rarest coincidence, be \( A_h \). If \( A_h \) chooses to work in the piece-rate range, then \( A_h \), who was indifferent to working under hourly wages, is at worst indifferent to working under piece rates, but more generally, strictly prefers the piece rate. If \( A_h \) earns rents under the new plan, then \( A_h \) is no longer the marginal worker. There exists an \( A^*h \) with \( A^*h > A_h \) who would now be the marginal worker, i.e., the worker for whom

\[ U(bf(X^*(A^*h), A^*h) - K, A^*h) \]

\[ = U(W^*(A), X^*(A)) \]
where $X^*(A^h)$ is defined as the effort for type $A^h$ under piece rates $b$ and where $W^*, X^*$ are the wage and effort on the alternative job.

Also, if any accept the wage guarantee, then surely $A_0$ accepts the guarantee. We know that $A_0$ is willing to work for $W$ at effort $e_0$ because $A_0$ worked under these terms before. Furthermore, since the guarantee has not been made any more attractive, no one with $A < A_0$ is willing to work for the guaranteed wage. Since the lower bound on ability remains the same and the upper bound does not fall and generally rises, average ability does not decrease and generally increases after the switch to piecework.

PROOF OF PROPOSITION 3:
From the Proof to Proposition 2, $A^*_{h_1} > A_{h_1}$. But $A_0$ cannot rise because the wage guarantee is still available so $A_0$ remains willing to work. This is sufficient to imply that range or variance in ability rises. Also, since all workers choose to produce $e_0$ under the hourly wage, but some produce in the piece-rate range with the new Scheme, positive variance in $A$ implies positive variance in $e$ under piece rates.