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Rewarding the Factory Workers: How to Select the Right Measures for an Effective Pay-for-Performance System

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: A Performance related pay (PRP) plan rewards employees with a financial payment, either consolidated or non consolidated, following an assessment of their performance and, typically, the achievement of objectives. Many different types of PRP schemes have been developed over the years. Regardless of the scheme chosen, a particularly critical factor in the design of a performance-related pay (PRP) plan concerns the choice of parameters or indicators on which variable pay should be determined. The research goal of this work is to develop an analytical model that can help companies to identify the optimal set of these parameters.

Methodology: The model proposed in the paper has been developed through an empirical research methodology involving a large sample of companies. Data were collected by means of a questionnaire distributed to companies which have implementing for at least ten years a performance-related pay (PRP) scheme for shop-floor workers.

Results: Descriptive and interpretative analysis of empirical results have identified a set of relationships between some company characteristics and the use of specific indicators for measuring the bonus to be given to the shop floor workers. The proposed model correlates three different typologies of companies (i.e. make to stock, make to order and engineering to order) with different types of indicators (i.e. profitability, productivity, efficiency and quality) which have to be

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used for bonus calculation. After having recognized to which category a firm belongs, it can easily identify the types of indicators to be used.

Originality: The proposed model can actually help companies to identify the optimal set of parameters on which basing the PRP plan. A set of strong relationships have been recognized between some company characteristics and different types of indicators that should be employed for determining the variable bonus for shop-floor workers.

Keywords: Performance appraisal; pay; incentive schemes; human resource management; performance measurement.

1. INTRODUCTION

Incentive pay or performance-related pay (PRP) has a long standing tradition in economic analysis and policymaking. From the Classical economists [1,2] to analysts and practitioners, compensation systems based on employee performance are seen as a way to correct some of the imperfections in labour, product and capital markets that affect the employment relationship.

Many different types of PRP schemes have been developed over the years: Individual Performance Awards, Team Awards, Gain-sharing/Productivity Awards, Cash Profit Sharing Awards, Business Incentive Awards, Special Recognition Awards and so on [3]. Most of the literature has shown that these PRP systems do have a marked impact on employee and organization performances. The evidence is drawn from a variety of sources including descriptive reviews [4,5] meta-analyses [6], experimental studies [7,8], and professional human resource program assessments [9]. However, the evidence obtained in the empirical research is mixed and some authors point out that the adoption of PRP does not always mean advantages and benefits for firms and workers [10].

The literature on the PRP schemes presents different analysis perspectives, the most frequently examined items are:

- factors which influence the adoption of the PRP plan;
- the role of environmental variables in designing the PRP plan;
- the level of measurement (individual, team, business unit, or the entire organisation);
- how to monitor and evaluate the PRP plan;
- the role of the unions in the success or failure of a PRP plan;
- the indicators on which variable pay should be based.

The last item in the preceding list plays a critical role in the design of a PRP plan. The problem that an employer faces is whether the parameters that are going to be used for quantifying performance really do reflect increased profits. In other words, the concept of sharing can really only be introduced if s/he is sure that extra “earnings” have been generated by improved performances.

The research goal of this work is to develop an analytical model which enables to investigate the choices made by companies when defining the indicators on which base the bonus. In other words, we intend to develop a model of analysis that can help companies to identify the optimal set of parameters on which basing the PRP plan. This model should be a contingent model in the sense that the choice of which parameters to employ is inevitably affected by business context.

The model has been developed through an empirical research methodology. A large sample of companies which have adopted a PRP scheme has been analysed. First, a descriptive analysis of the indicators utilized by these companies is carried out. Alongside the descriptive analysis, an interpretative analysis is performed in order to build the model which is able to support the company in identifying the appropriate parameters. Therefore, this study aims to build a reference tool for companies that would like to move in the direction of the company labour’s agreements according to the PRP logic.

In the following section, the problem of the correct identification of the indicators is discussed in theoretical terms.

2. THE INTRODUCTION OF PERFORMANCE-RELATED PAY: A REVOLUTION IN ITALIAN INDUSTRIAL RELATIONS

PRP systems have existed in various forms for the last 50 years but in recent years academic

and practitioner interest in PRP has been increasing. Basically, the increased interest in new forms of payment has arisen in response to fundamental changes in the nature of work [11] [12]. In all likelihood, these changes are linked to the decline of mass production and the rise of new production models based on techniques such as Just-in-Time (JIT) and Total Quality Control (TQC) which have questioned the traditionally job-based payment structures.

The Italian situation has for many years been characterised by a salary structure based on a series of automatisms and fixed components that were subject to national contracts. In the years immediately after the Second World War, a centralised system for wage bargaining was developed which allowed for only a very limited level of bargaining at the level of firms. However, it did leave room for some forms of worker incentive, basically piecework, a payment system based on work output rather than on the time for which an individual's work effort is available.

This was to a certain extent modified during the 1960s and 1970s when the role played by Unions at the level of the firm expanded to its greatest extent. But growing concern about the coming economic and employment crisis that followed the first shocks caused by rising oil prices and by high levels of conflict within firms during the second half of the 1970s, helped reinstate the tendency to centralise industrial relations.

Not until the early 1990s, following actions by central government, did negotiations begin which aimed at a radical reform of salary structure and of the national bargaining system itself in order to encourage the adoption of flexible bonus and pay incentive schemes in Italy[13]. These negotiations culminated in the Protocol of 23 July 1993 (named "*Premio di Risultato*" – Payment-by-Results), which was drawn up between the Italian government, Union representatives and Employers confederations. The cultural impact of this Protocol on company-level bargaining was undoubtedly considerable. The qualifying principle of this Protocol is the assumption of company performance as the point of convergence of interests of the workers and the company. This Protocol also made it possible for the first time to link part of the salary to the results achieved by the firm, in terms of improvements in efficiency, quality, production and financial performances.

The fundamental points of this Protocol are:

- two levels of bargaining are provided for, at the national and the single firm level.
- the Premium based on Results is a bonus/extra payment, that is calculated on the basis of how successful the firm has been in carrying out programmes, agreed between management and the employees, which aimed to increase those relevant aspects that help to improve the firm's competitiveness;
- extra payments are both reversible and variable, and are based on *multi-factor* incentives (productivity, efficacy, quality, flexibility, participation) which are very different from those of the previous decades which were irreversible, in fixed sums and included in the salary structure permanently.

Various studies have highlighted the positive benefits this Protocol has had on the performance of firms and more generally on industrial relations in Italy [14-16].

As previously said the choice of the indicators on which to base and award the bonuses is a crucial topic when building up a PRP plan. For this reason, next section will deepen this issue.

3. PROFIT SHARING VS GAIN SHARING

In PRP scheme design, a particularly important aspect is the choice of the parameters or indicators that, treated under periodic measurement, are the basis for the calculation of the bonus to be paid out to the workers. For the entrepreneur, it is important that the improvement of the values on the chosen parameters is undoubtedly linked to a real improvement of firm profit. In fact, a PRP plan is a contract oriented to the so-called "profit sharing". An operation of "sharing" can be proceed if there is a guarantee that additional "profit", resulted from the performance improvement, is generated. Therefore, there is the need on behalf of the entrepreneur to have the guarantee that the chosen parameters for the bonus quantification have a clear correlation with the generation of an additional profit.

Traditionally, the parameters utilized for the construction of a PRP scheme can be grouped into the following classes [17-20]:

- a) profitability parameters
- b) productivity parameters
- c) efficiency parameters
- d) quality parameters
- e) participation parameters

Following a more detailed description of abovementioned parameters:

- a) profitability parameters. These are various types of parameters which are derived from the firm financial statements, mainly from the Income Statement, for example the EBITDA. Usually, the parameters of profitability are compared over two consecutive years and the bonus is given to workers if they improve.
- b) productivity parameters. It is a measure of the amount of produced quantities per time unit in relation to the amount of work resources consumed for obtaining them. The bonus is given to the workers if the parameters are above a predefined value.
- c) efficiency parameters. It is a measure of the quantities produced per time unit in relation to the amount of labour resources consumed for obtaining them. The quantities produced are not measured in physical terms as in the case of productivity parameters, but through the standard time attributed to each product obtained. Also in this case the bonus is distributed to the workers only if the parameter is above a certain threshold.
- d) quality parameters. These parameters are aimed at measuring the no-quality production (i.e. production that does not meet quality standards; for example scraps, reworks, waste,)
- e) participation parameters. These parameters are designed to measure the worker's willingness to accept individual working-time flexibility (for instance overtime, daily flexitime, compressed working week,). These parameters are used for providing a bonus "ad personam", normally formulated in the form of a correction of the collective bonus based on the other parameters. Often these participation parameters are included in order to discourage absenteeism.

Only the profitability parameters are gathered from the company financial statements, the others are derived from measurements of phenomena physically detectable. In general, companies have three options when choosing

the parameters for a PRP plan: stipulate contracts in which wages are related only to technical/physical indicators or only to economic/business ones or, finally, to a combination of the first indicators with the second.

In the first case, the so-called *gainsharing* is implemented [21]. With this method, the variable component wage is defined by indicators linked to the achievement of particular objectives of productivity/efficiency or cost reduction, established for the factory, the plant, the division, or for specific group of workers. In these cases the individual worker obtains the advantageous outcomes of a communal orientation of the specific production unit where s/he is employed. Examples of gainsharing plans are Scanlon, Rucker, Improshare.

As an alternative to gainsharing, in *profitsharing* the employees see the variable component wage calculated on the basis of the financial economic results of the company, deduced typically from the company profitability indicators. They are therefore collective objectives (and indicators), distant from the performance of the individual employee, which imply the company desire to create labour agreements that favour risk subdivision.

Whatever choice is made, the utilized parameters should be known and comparable, easily understandable and translatable with simple calculations in payroll, under the effective control of the workers and directly influenced by their actions and, where it is possible, not affected from the factors which are different from our measurement.

From this point of view, gainsharing approach can have the following main problems:

- First of all, productivity and efficiency are necessary but not sufficient conditions for economically significant results: The factors can be improved but it may not be improved the profitability and, therefore, the firm ability to pay. For example, despite the productivity growing, the net income of company may decrease as a result of lower prices of products and/or due to decrease in quantities sold;
- Low motivational value because of the distance between individual contributions and the aggregate result, in a situation in

which the problem of the free rider becomes more consistent;

- The risk of rewarding someone who starts from low levels of inefficiency, and of frustrating others who already operate at high levels of efficiency;
- The risk that additional efficiency generates high costs which may not be compensated by the benefits (including the administrative cost related to the programme of incentives).

Two fundamental problems are also found in the profitsharing mechanisms:

- Low impact on worker behaviours, when the distance between individual contributions and the business financial performance is substantial;
- Limited control on the part of shop-floor workers: In profit sharing PRP plans, employees have difficulty trusting the financial data. They have small or no control of any measure. Financial results may be affected by management choices (for example industrial depreciation rates, pricing policies, etc.). This is the reason why employees prefer operational measures, they have more control on them.

Based on the considerations made so far, it emerges strongly that the choice of indicators represents a critical and central issue for a company which intends to set up a PRP scheme.

In this paper researchers intend to develop a model of analysis that can help companies to identify the optimal set of parameters on which PRP plan is based. It should be a contingent model in the sense that the choice of employable parameters is inevitably affected by business context. The main hypothesis that this study wants to explore is the existence of a correlation between some firms' characteristics and the parameters on which the bonus calculation is based. In particular, we think that (1) ways of responding to demand and (2) technological profile of manufacturing processes are two important variables that influence the choice of parameters.

More specifically, this study aims to investigate the following research hypothesis:

H(1): There is a relationship between how a company responds to market demand

(i.e. make to stock or make to order or engineering to order) and indicators used in the PRP plan.

H(2): There is a relationship between how a company measures cost performances for bonus calculation in a PRP plan and firm's basic characteristics such as product and process variety, production volume, level of mechanization and automation of production.

H(3): In choosing the parameters on which variable pay should be determined, firms prefer to use technical/physical indicators such as productivity and efficiency rather than profitability parameters gathered from the company financial statements.

The remainder of the paper is organized as follows. In section 3 the research methodology and the sample characteristics are examined. Sections 4 and 5 contain, respectively, the descriptive analysis and the interpretative analysis of the empirical results. The proposed model is depicted in section 6. The last section contains the conclusions and managerial implications.

4. RESEARCH METHODOLOGY

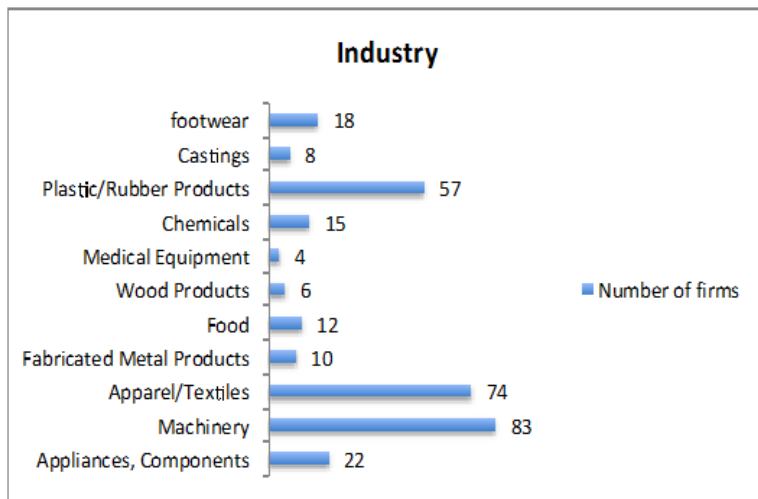
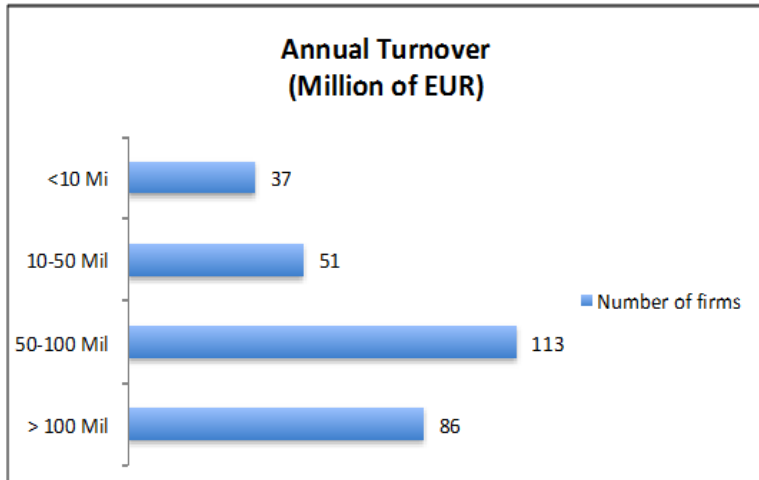
The paper is based upon an empirical research field. The research was conducted in Italy at the end of 2015. The data were collected by means of a questionnaire distributed to companies which have implementing for at least ten years, a PRP scheme for shop-floor workers. The questionnaire was mailed to a sample of 1,285 companies. The questionnaires sent back were 287. The data of each 287 companies has been suitably encoded in a database in order to easily perform the subsequent processing. The relevant features of the companies involved are:

- All of them are located in the Northeast of Italy, one of highest industrialized geographical area in Italy and in Europe
- They belong to the most representative industrial sectors of the area;
- they are all members of Confindustria (General Confederation of Italian Industry) which is the lead organization representing the manufacturing, construction, energy, transportation, ITC, tourism and services industries in Italy.
- They have an active PRP contract at least since 2005.

A questionnaire was sent to these companies, containing 46 questions divided into three sections:

- First section: 14 questions about the firm-market interface: Type of product, product variety, production/sale volume, ways to respond to market demand (for example products are manufactured based on demand forecasts or products are designed and manufactured based on customer specifications.), customer lead times. This set of questions was addressed to the head of the commercial/sales area.
- Second section: 17 questions were designed in order to collect data about the production system: types of manufacturing technologies, degree of labour/capital intensity; size of production batches; relevance of set-up; degree of production outsourcing. This set of questions was addressed to the head of production or plant manager.
- Third section: 15 questions were designed in order to collect data relating to the PRP plan: the number and type of indicators used, the importance of the variable bonus in relation to the whole salary, factors which have influenced the adoption of the PRP plan; organizational and management aspects of PRP scheme. This set of questions was addressed to the human resources manager.

Fig. 1 outlines main characteristics of the 287 companies surveyed.



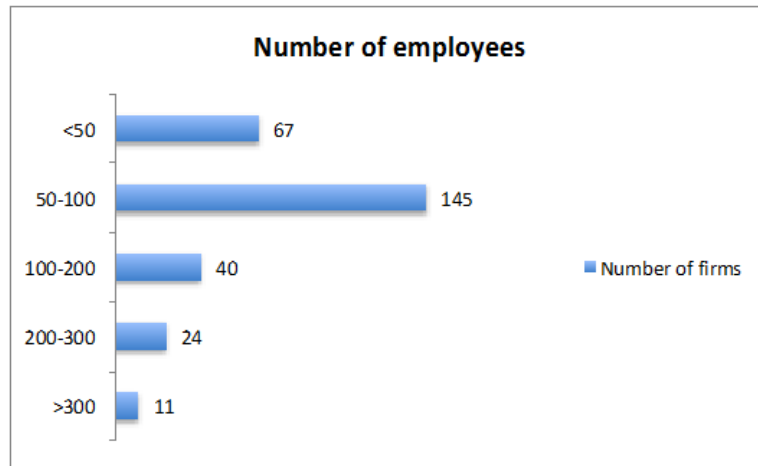


Fig. 1. Sample characteristics

5. RESULTS OF EMPIRICAL RESEARCH: A DESCRIPTIVE ANALYSIS

This section presents a descriptive analysis of empirical research results. In the next section, an interpretative analysis of these empirical evidences will be developed in order to discuss the criteria adopted by the sample companies for choosing the parameters on which the payment of bonus to the workers is based.

The outcome may be summarized as follows:

- 1) Only 29 companies utilize a single type of indicators for the bonus quantification to be paid to their employees. In particular, 21 of these companies employ exclusively profitability parameters.
- 2) Most of the companies prefer to adopt a mix of indicators of different nature. The combinations empirically identified are the following:
 - 37 companies: A mix of profitability and productivity indicators;
 - 43 companies: a mix of profitability and efficiency indicators;
 - 63 companies: a mix of profitability and quality indicators;
 - 41 companies: a mix of productivity and quality indicators;
 - 45 companies: a mix of efficiency and quality indicators;
 - 29 companies: a mix of profitability, productivity and quality indicators.
- 3) All companies utilize participation indicators thanks to which an "ad

personam" bonus is defined. This "ad personam" bonus is normally formulated in the form of a correction of the collective bonus based on the other indicators. These parameters are often included in order to discourage absenteeism. The main participation indicators identified are shown in Table 1.

- 4) Companies (57,14% of the total) utilize at least one indicator of profitability for bonus calculation. Indicators are drawn from officially corporate financial statements, in particular from the profit and loss statement. The main indicators are listed in the Table 2.
- 5) 107 companies (37,28% of the total) utilize at least one indicator relating to productivity performance for bonus calculation to be given to workers. The productivity is calculated, in general terms, as the ratio between the amount of output produced and the amount of resources consumed, in our case the measured productivity is in relation to the labour's performance. The variety of productivity indices utilized by the companies is represented in Table 3.
- 6) 92 companies (32,05% of the total) utilized at least one indicator of efficiency for bonus calculation. The classic formula of an efficiency indicator is the ratio of real output, measured by the standard times, and real input according to the following relationship:

$$\frac{\sum(X_i * T_i)}{\text{Labour hours}}$$

Where X_i and T_i are, respectively, the quantities produced and the standard times assigned to each product. The efficiency indicators used are shown in Table 4. All the indicators refer to the classical definition of efficiency.

Table 1. Indicators used by sample companies to measure participation performance

Participation Indicators	
Collective absenteeism (ratio of the number of presence days on the total number of workable days in the year for an organizational unit or the entire plant)	
Individual absenteeism (ratio of the number of presence days on the total number of workable days in the year for a single worker)	
Willingness to work overtime	
Willingness to accept flexible working times	
% of total hours lost to absenteeism	

Table 2. Indicators used by sample companies to measure profitability performance

Profitability indicators	
EBITDA (Earnings before interests, taxes, depreciation, amortization)	Sales Revenue/Number of Employees
Total gross profit margin	EBITDA/Sales Revenues
Production costs	Net Income/Sales Revenue
Cost of goods sold	Total labour cost
(Wage + Salaries)/Sales Revenue	Sales Revenue/Production Cost
Gross Margin/Sales Revenue	Inventory turnover
Sales per employee hour	Gross profit % by department/ team
Total overtime cost	Overtime labour cost ratio
Labour cost as % of sales	

Table 3. Indicators used by sample companies to measure labour productivity performance

Productivity indicators
Output per period (units)/Number of employees at work
Units produced per period/Labour hours per period
Units produced without defects per period/Labour hours per period
Output per period (units)/Number of employees at work (only direct labour)

Table 4. Indicators used by sample companies to measure labour efficiency performance

Efficiency Indicators
$\sum(X_i * T_i) / \text{labour hours}$
$\sum(X_i * T_i) / \text{average number of workers}$
$\sum(X_i + R_i - S_i) * T_i / \text{labour hours}$, in this case X_i represents units without defects, R_i represents units that required rework and S_i represents discarded units

Table 5. Indicators used by sample companies to measure quality performance

Quality Indicators
Internal quality (No. of defects/ Total no. of goods produced)
Internal quality (number of errors)
Internal quality (number of scraps and/or defects)
Internal quality (total time for rework/total time worked)
Internal quality (quantity of material wasted)
External quality (number of complaints from customers)
External quality (number of customer returns)
External quality (customer satisfaction index)
External quality (measure of costs related to warranty)

7) 182 companies (63,41% of the total) utilize quality indicators for bonus calculation to be given to workers. As seen in Table 5, in most cases the so-called internal quality is measured. Measures may refer to errors, defects, scrap, rework, waste, etc. in a given period of time. This data can be evaluated in absolute terms or compared with different parameters (turnover, total production, total hours worked, etc.). In some few cases (22 equal to 7,66% of the total number of companies), the payment of bonus is linked to indicators which measure the so-called external quality (the one that is perceived by customers). Some companies measure the customer returns or the number of complaints from the customers, other the overall customer satisfaction or even the costs related to warranty period of the product; In all these cases, these values are related to a predetermined target value.

- Quality - defined as compliance with the specifications ("internal quality") and as product/service design quality ("external quality");
- Speed - quick response to customer requests;
- Dependability - the ability to maintain the "promises" to the customer in terms of delivery date;
- Flexibility - product flexibility (ability to introduce new products), volume flexibility (ability of the operation to change its level of output), mix flexibility (ability to provide a wide range or mix of products) and delivery flexibility (ability to change the timing of the delivery);
- Cost.

6. INTERPRETATIVE ANALYSIS OF EMPIRICAL RESULTS

In the previous section we have described the indicators that sample companies utilize in order to calculate and distribute the bonus in payroll. In this section we want to investigate whether there is some kind of correlation between the indicators utilized by these companies and some characteristics of their business and supply chain model, such as:

- products typology for market response strategy;
- manufacturing organization and production planning methodology;
- complexity of the logistics system in terms of manufactured products variety, process variety and make or buy strategies.

The development of this interpretative model could be a useful reference tool for all those companies that intend to develop a corporate agreement in line with the logic of the PRP. In order to develop the model it is necessary to identify, in the first place, the competitive priorities (also called critical success factors, performance objectives or competitive variables) that theoretically could be used in a PRP scheme.

Slack et al. [22] point out that competition between companies is realized through five basic competitive priorities:

Among these competitive variables, which are coherent with the purpose of a performance-pay system? Which performance makes more explicit the direct link between bonus and shop-floor workers behaviour? As mentioned above, the effectiveness of a performance-related pay is linked to its ability to encourage improvements in labour performance; This ability is strongly dependent on the choice of performance indicators. Indicators taken as reference for the remuneration variability should be able to directly influenced by worker; the more unclear is the relationship between worker commitment and contribution and performance indicators, the less effective is the expected result regarding to behaviours due to monetary incentive. In this perspective it is important to analyse the five competitive performances proposed by Slack et al. [22].

First of all we examine the "external quality" performance, which concern the design adequacy of the product/service towards the target-customer needs. Since workers do not have any possibility to influence the relationship between products offered by the company and customer needs and expectations, this performance type cannot be utilized for the provision of a bonus for the shop-floor workers. In fact, the results of the empirical survey confirm this statement, considering the limited number of companies using indicators related to external quality perceived by the customer.

As regards the "internal quality", this usually refers to the amount of:

- Errors
- Defects

- Time for rework
- Material waste

All these entities are not quality performance but rather cost performance, in the sense that they essentially represent efficiency measures. In other words, these measures of the internal quality may be utilized as a correction factor in the determination of cost performance. For this reason, please refer to the following considerations on production costs.

Speed performance - quick response to customer requests - is connected to the physical characteristics of production system and also to the operating criteria adopted to manage the various manufacturing activities. This is especially true for those production systems where speed is determined by a complex set of commercial choices (e.g. orders anticipation or postponement) and production planning strategy; consequently the shop-floor workers may barely affect the indicators linked to that category of performance and, in any case, their real contribution is difficult to measure. In the case of "engineered to order" products (manufactured in small or very small volumes), the rapidity to respond to customer could present a greater correlation with the factory workers performance. Since the very low standardization of operations and the significant level of discretion that distinguishes operational tasks in this production context, the time for the physical realization of the product is a performance that is directly controlled by the worker.

Actually no company in the sample has based the calculation of bonus using speed as a performance indicator; This fact suggests avoiding the application of speed-based indicators. What emerges from the empirical analysis is that companies prefer to measure the willingness of workers to guarantee working hours flexibility in relation to the company production needs; flexible working hours and a willingness to work overtime may be important "parameters of participation" on which to base the formula of a PRP scheme.

The same considerations can be developed regarding dependability. Only for "engineered to order" companies it may be possible to support and validate a bonus for the workers related to dependability: in these contexts it may be assumed that on-time delivery of each order can be linked to the performances of a defined workers group. However, no company of the

sample utilizes dependability as a base for the calculation of bonus to be given to employees; this evidence suggests avoiding the application of such indicators to assess the bonuses payment. As seen before, companies prefer to measure the workers' willingness to provide flexibility of working hours as an important factor to maintain the "promises" to the customer in terms of delivery date.

As regards flexibility performances, especially product flexibility and mix flexibility, they are also closely linked to the structural characteristics of the production system. Therefore, they are inadequate for the purpose of PRP; Contribution of the shop-floor workers in the progress of these performances is difficult to identify and quantify. In fact, no company in the sample utilizes such indicators. Instead, volume flexibility and delivery flexibility could be related to the workers' willingness to ensure flexibility of working hours. In this perspective it is interesting to note that all companies in the sample utilizes "parameters of participation" in order to define the formula for calculating the bonus.

Lastly, the cost performance usually refers both to the direct costs and to the indirect production costs, as follows:

$$\text{Total cost} = \text{direct cost} + \text{indirect production costs}$$

Direct cost is the sum of the costs of materials and costs of manufacturing processes (direct labour). Indirect production cost refers to activities such as production planning, logistics management, quality control, and suppliers relations management and so on.

First of all, we consider the case of those companies in which the amount of the direct costs represents only a small part of the cost performance. In this case the total cost is approximated to the indirect costs:

$$\text{Total cost} \approx \text{indirect production costs}$$

When total cost is significant due to the costs of indirect activities, the only way for measuring total cost performance is to use data derived from the company financial statements (i.e. profitability parameters). The analysis of the sample confirms the presence of a strong correlation between the use of profitability ratios and high level of complexity of the manufacturing and logistic system.

Now, we consider the case where direct costs are the largest portion of the total cost:

Total cost \approx direct production costs

The analysis of the empirical results shows that direct costs has been calculated in two different ways:

- By measuring productivity and/or efficiency. This way is feasible if there is the guarantee that the measure of productivity/efficiency is in inverse relationship with the direct production costs (limited to the labour component of this cost). Firms which determine direct costs through productivity/efficiency parameters are characterized by a production volume of homogeneous products that can be measured by counting the units produced in physical terms or in terms of standard times;
- By measuring profitability: when products that are manufactured are very heterogeneous, it will not be possible to use measures of productivity/efficiency.

To summarize the findings from the empirical analysis:

- 1) In all companies which use special/dedicated technologies for manufacturing a small range of products in high volumes, the measure of cost performance is always performed by the productivity measures;
- 2) In all companies that utilize much more flexible/universal technologies, suitable for manufacturing a large range of products in small volumes and based on customer specifications, the cost performance is always measured by profitability indicators. In other words, the output of the production system, as well as the resources needed as input, can be appraise only through the comparison between revenues (total or partial) and costs (full or partial) that enables these revenues;
- 3) Much more complex is the analysis of those companies which are between the two extremes mentioned above. In some cases they are closer to those companies that make products in high volume and low variety using mostly special/dedicated technologies. In other cases, they are closer to those companies that make

products in low volume and high variety using mostly flexible/universal technologies. In any case, these are companies that manufacture products whose physical characteristics and production processes are "a priori" well-known (i.e. not defined from customer specifications). This means that in many cases it is available a database of standard times. In industrial engineering, the standard times are the times required by an average skilled operator, working at a normal pace, to perform a specified task using a prescribed method. They include appropriate allowances in order to enables the workers to recover from fatigue and, where necessary, an additional allowance to cover contingent elements which may occur without having been observed.

When in the production processes are preferably used special/dedicated technologies, if there is a standard time database, it is possible to calculate the direct costs of product through efficiency measures. Without this database, the companies in this category show a clear use of productivity parameters in order to measure the direct production costs performance. The use of special and dedicated machines is consistent with an output characterized by medium-low variety and medium-high production volumes; therefore it is sufficiently homogenous and measurable by productivity indicators.

When in the production processes are preferably used universal/flexible technologies, if there is a standard time database it is still possible to calculate direct production cost through measures of efficiency. Without this database, companies show a clear application of profitability parameters. The use of flexible and universal machines is coherent with an output characterized by a medium-high variety and low-medium production volume. It is a non-homogeneous output that involves the use of profitability indicators.

These considerations are summarized in Fig. 2.

7. THE PROPOSED MODEL

The results of the analysis described in the previous section have identified a set of relationships between some company characteristics and the use of specific indicators for measuring the bonus to be given to the shop floor workers.

In this section, building upon the results obtained, we would like to formulate a model able to interpret the behaviour of companies when selecting the parameters or indicators on which base the PRP plan. As it will be explained shortly, the models correlate three different typologies of companies with different types of indicators which have to be used for bonus calculation. Our expectation is that such model can help those firms that intend to implement a PRP plan. After having recognized to which category a firm belongs, it can easily identify the types of indicators to be used.

As previously mentioned, the model development requires singling out different reference groups of firms. In order to identify these reference groups we have to choose some company characteristics that are significantly positively associated with different types of indicators. These characteristics refer on one hand to the firm-market interface, on the other hand to the production system profile. In the first case the focus is on elements such as product type, product variety, way to respond to market demand, customer lead times. In the second case, the following elements are taken into consideration: type of technology used in manufacturing processes, degree of production repetitiveness, production volume, level of product and process standardization.

These variables are the basis of numerous classification frameworks of production systems proposed in the literature. In particular, using the typology of customer order decoupling point proposed by Wortmann [23] and the product-process matrix of Hayes and Wheelwright [24], manufacturing firms can be divided into three reference groups:

- MTS (Make to stock) production systems;
- TO (To order) production systems that encompasses classic typologies as ATO (Assemble To Order), MTO (Make to Order) and PTO (Purchasing To Order)
- ETO (Engineer to order) production systems.

The MTS mode consists of the fabrication of large quantities of products in low variety. Companies have a catalogue (products are designed ex-ante, i.e. before they are offered to the customers) and the production is

programmed according to demand forecasts. The low number of product variants combined with a linearization of production flows allows to utilize dedicated resources, very specialized and with very short lead time for responding to the orders.

Conversely, in ETO companies the processes of design, engineering, industrialization and production are activated ex-post (i.e. after receiving product specifications from customers). Product variety is very high, production volumes are small, production flows are irregular and variability of the routings is very high. Manufacturing these products requires high flexibility of production system, which is obtained by the use of generic and multipurpose-use equipment. The customer lead-time is generally very long.

To-Order term identifies a large mix of companies that are very different from each other and are located between the two previous groups. In this category, we find companies that produce and sell products which have bill of materials and routings almost completely defined. Sometimes, these products are manufactured in a wide differentiated range of models, obtained through the assembly of a relatively limited number of standardized components and subassemblies. In other cases, products are adapted to customer's requests through a limited design effort starting from a basic model. Depending on the production volume, To-Order companies utilize machines and manufacturing technologies which can be more dedicated and specialized or more flexible and universal.

The considerations made so far are summarized in Table 6.

Since we have defined these three classes of firms, we can now start to build the interpretation model. The model aims to specify, for each of these classes, the indicators to be used for the calculation and payment of the variable pay bonus.

Table 7 summarizes the empirical results regarding to the first four competitive performances previously seen: quality (external and internal), speed, dependability and flexibility.

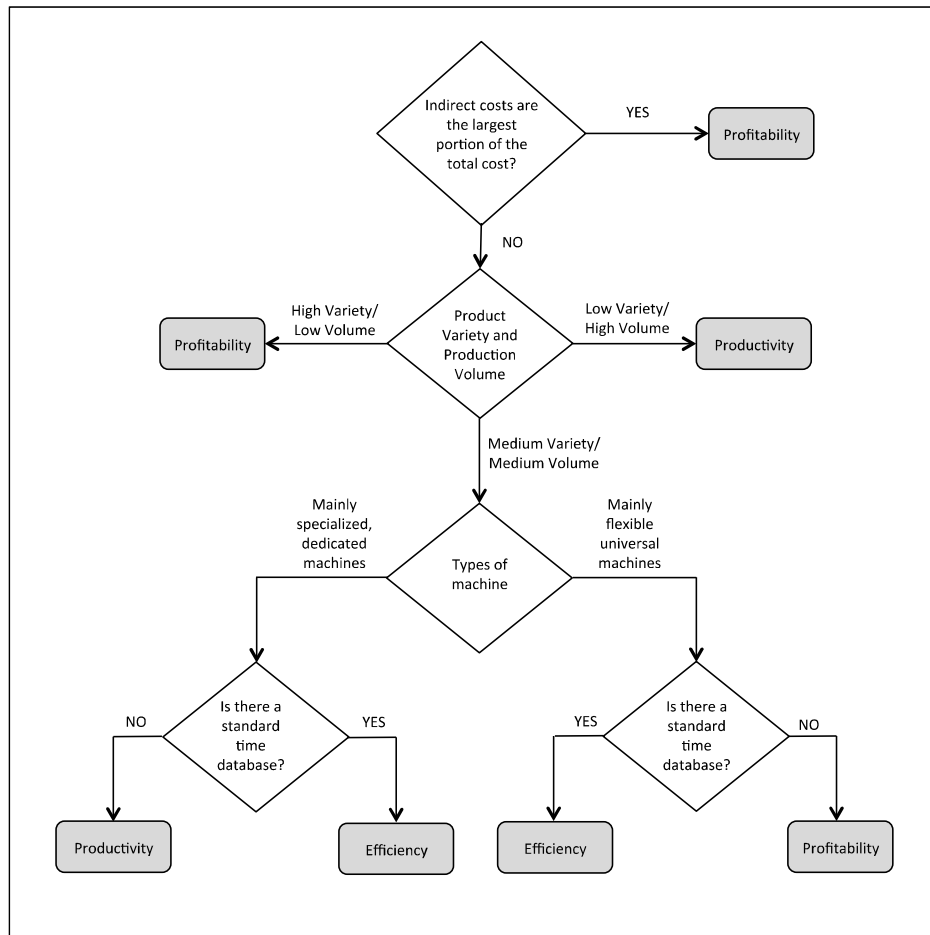


Fig. 2. Profitability, productivity and efficiency indicators for measuring cost performance

Table 6. Main characteristics of the three different groups of firms

	Make to stock production systems	To order production systems	Engineering to order production systems
Product Variety	Low	Medium	High
Production volume	High	Medium	Low or one of a kind
Catalogue	Yes	Yes	No
Product design and development	Products are designed ex-ante, i.e. before they are offered to the customers	Mixed way	Products are designed ex-post, i.e. after receiving product specifications from customers
Lead Time	Short	Medium	Long
Types of machines	Specialized, dedicated machines	Specialized or flexible machines	Flexible machines

The examination of the Table 7 allows us to formulate the following considerations:

- These four competitive priorities are never subject to direct measurement, they should not be used for the calculation and payment of the bonus to the workers;

- Measures of internal quality performance must be taken into account in a PRP plan but with the goal of correcting the measure of cost performance;
- Workers' willingness to adapt to flexible working time, to ensure, in other words, a high level of participation to the company's

production needs is of paramount importance. This is the key parameter that must be always considered for the bonus calculation and distribution. The direct measurement of this parameter indirectly determines the company's capability to be competitive in terms of time (speed and dependability) and of flexibility.

We try now to shed light on the companies' behaviour with regard to cost performance. Table 8 shows, for the three classes of companies, the typologies of indicators to use in order to measure cost performance and to calculate and distribute the bonus to workers. As seen, the overall cost is the sum of the direct costs and indirect costs. The examination of the Table 8 allows us to formulate the following observations:

- with regard to the indirect costs, companies have to utilize profitability parameters (i.e. parameters derived from the company financial statements), regardless of the group to which they belong;
- companies must adopt different parameters for measuring the direct cost;
 - MTS companies should use productivity parameters. When product variety is low and routings are well defined and stable, productivity measures are the most appropriate;
 - ETO companies should use profitability parameters in order to measure direct production costs. When product variety

is high and work cycles are not standardized, productivity and also efficiency indicators are not suitable to determine direct cost performance. The great variability of products and production processes imposes the use of profitability parameters;

- To-Order companies should generally use efficiency indicators for measuring direct cost performance. As product are available from a catalogue, the structure of their bill of material is fairly well defined and work cycles are almost stable, if standard time data are available, To-Order firms can measure quantities produced and consequently direct production costs. However, due to the great variability of situations found in this group of firms, other combinations are possible. When standard time data are not available, product variety is low and production takes place mainly with special machines, productivity parameters should be used for measuring direct cost performance. This fact is justified by the relative high standardization of the output. Conversely, in the absence of standard time data, if product variety is relative high and manufacturing makes mainly use of flexible, universal machines, companies should use profitability parameters. The reason for this is due to the variability of the output.

Table 7. How to measures Quality, Time and Flexibility performances for bonus calculation in a PRP plan

	Make to Stock	To Order	Engineering To Order
Quality Performance (External Measures)	Not measured		
Quality Performance (Internal Measures)	Measures of internal quality performance (scraps, defects, rework,...) must be taken into account in a PRP plan but with the goal of correcting the measure of cost performance		
Time Performance (Speed)	Not directly measured, firms must evaluate workers' willingness to accept individual working-time flexibility		
Time Performance (Dependability)	Not directly measured, firms must evaluate workers' willingness to accept individual working-time flexibility		
Product flexibility Performance	Not measured		
Mix flexibility Performance	Not measured		
Volume flexibility Performance	Not directly measured, firms must evaluate workers' willingness to accept individual working-time flexibility		
Delivery flexibility Performance	Not directly measured, firms must evaluate workers' willingness to accept individual working-time flexibility		

Table 8. How to measure cost performances for bonus calculation in a PRP plan

		Indirect costs	Direct costs	
			Specialized, dedicated machines	Flexible, universal machines
Measures of Profitability	MTS		Measures of Productivity	
	TO		Measures of Efficiency (when standard time are not available measures of Productivity)	Measures of Efficiency (when standard time are not available measures of Profitability)
	ETO			Measures of Profitability

8. CONCLUSIONS AND MANAGERIAL IMPLICATIONS

In the last decades, within the wider Human Resource Management debate, a central role has been played by the analysis of those changes in compensation systems driven by the use of new methodologies and technologies and the related changes in the organisation of production and work. If improving competitiveness is not achievable without significant contribution of the workers, one possible way to ensure this contribution is to define an additional and variable remuneration. For firms which have the intention to set up a performance-related pay (PRP) plan, a very important aspect is the identification of parameters to base the calculation of the bonus to distribute to the shop-floor workers.

Our aim was to develop a model of analysis that can help companies to identify the optimal set of parameters on which basing the PRP plan. This paper has focused on the relationship between some characteristics of the company production system and the types of parameters to be measured.

First of all, based on the work of Slack et al.[16] we have identified five basic competitive priorities: quality (defined as internal and external quality), speed (quick response to customer requests), dependability (the ability to maintain the "promises" to the customer in terms of delivery date), flexibility (in terms of product flexibility, volume flexibility, mix flexibility and delivery flexibility) and cost.

Secondly, companies have been divided into three classes: MTS (Make To Stock), To-Order and ETO (engineering To Order).

- For each of these three groups, the proposed model (see Table 7 and Table 8)

suggests the appropriate indicators to pick for the PRP plan. The managerial implications that emerge can be summarized as follows:

- do not use parameters related to time performance (both speed and dependability), external quality and flexibility (in its various types). The reason lies in the inability to determine a link between these performance improvements and the real benefits that could be shared with workers;
- it is important to define appropriate indicators in order to measure the willingness of workers to guarantee working time flexibility in relation to the company production needs. This measure allows the definition of bonus at the individual level;
- cost performance measurements are the key indicators to base the calculation of the bonus for workers. The cost performance must always be rectified by measuring the number of errors/scrap/defects/wastes generated by the production processes;
- in many cases, companies cannot refer to physical parameters and they have to use profitability ones derived from the financial statements. In these cases, firms must be aware of the problems that could arise due in particular to the low impact of these indicators on individual behaviour and to the limited possibilities of control by workers. If the use of profitability parameters is obligatory, it is important to choose parameters derived from only the Income Statement and related to manufacturing operations such as EBITDA, without taking into account those elements beyond the control of workers (such as depreciation charges);
- if cost performance significantly depends on the indirect production costs, cost

improvements must be measured with profitability parameters.

- if cost performance predominantly depends on direct production costs, cost improvements should be measured with physical parameters (productivity and efficiency), because they have a clear correlation with the generation of an incremental profit thanks to the performance improvement resulting from the contribution of the workers. However, the use of these parameters of efficiency and productivity is only possible when the manufactured products are sufficiently homogeneous and the firm has standard time data;
- if product variety is high and production volume is low and if the firm has not standard time data, it is necessary to use profitability parameters. In this situation, it becomes difficult for companies to have significant measures of the total amount produced per time unit and, then, to utilize indices based on physical parameters.

The future scope of this research is to test the interpretative framework developed in a wider group of companies in order to assess both its limits and potential and also to highlight possible improvements. In this perspective, researchers have come in touch with Confindustria. Founded in 1910 Confindustria is the Italy's main employers' confederation. It brings together 150.447 voluntary member companies of all sizes, amounting to 5.440.125 employees. Confindustria provides several services to his members through regional offices. In particular it helps employers in setting up the PRP plan and to negotiate it with the trade unions. Starting from mid-2016 some Confindustria's regional offices situated in the North of Italy are using the framework as a platform for building trade union agreements for their affiliated companies. Using the framework in hundreds if not thousands of business cases will allow the researchers to gather important feedback for a model revision aimed at make it more strong.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX 1

Example of questions to be found in the questionnaire

Describe the products made at this plant:

How many levels of management are there in the plant, from first level supervisor on up to plant manager? (Example: supervisor, superintendent, plant manager=3 levels). _____

How many products are manufactured at this plant? _____

What per cent of the production volume is manufactured in the following ways?

Manufacturing cells _____%	Dedicated flow line(s) _____%
Mixed model line(s) _____%	Other ways _____%

Describe the degree to which this firm is vertically integrated (owns elements of the total chain, from transforming a raw material to putting it in the hands of the consumers):

Not at all _____	Low _____
Medium _____	High _____

How many customers does this plant serve (approximately)? _____

How many orders does this plant process each month, on average? _____

The production process in this plant is best characterized as follows:

One of a kind _____%	Small batch _____%
Large batch _____%	Repetitive/line flow _____%
Continuous _____%	

Overall, how extensively are products customized in your plant?

Highly customized _____%	Somewhat customized _____%
Standard, with custom options _____%	Somewhat standardized _____%
Highly standardized _____%	

What per cent of the equipment and processes that you currently use in manufacturing falls into each of the following categories?

Standard equipment purchased from vendors	_____%
Vendor equipment which was modified for our use	_____%
Proprietary equipment designed by our company	_____%
Proprietary equipment designed and built by our company	_____%

For each union within your plant, list the year that it was certified as the representative for its bargaining unit, along with the name of the union.

Union name _____ Year Certified _____

Union name _____ Year Certified _____

Union name _____ Year Certified _____

The manufacturing cost structure: please give the breakdown for your most recently completed budget year.

Bought-out raw materials	___%	
Purchased components, assemblies and packaging	___%	___%
Energy cost	___%	
Bought-out services (rent, rates, equipment hire, etc.)	___%	___%
Direct labour	___%	
Indirect factory labour	___%	
All other labour (including staff & managerial)	___%	___%
Depreciation charges	___%	
Other	___%	

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