

Modern Management Systems for Higher Margins

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ABSTRACT

Maximising margins in today's competitive international commodity markets demands superior productivity. This requires more than selecting the best equipment. It requires continually improving the efficiency of production, commercial, marketing and administrative processes under the control of solid modern management systems.

This paper introduces an integrated way of working that includes proven management systems for successfully changing work practices and attitudes, developing managers and increasing accountability. It introduces a proven methodology for systematically involving people in sustained true continuous improvement of processes for maximising productivity, safety and revenue while minimising costs.

The paper gets down to basics and shows how traditional systems entrench outdated and sub-optimal management and work practices. It describes how traditional performance measurement and reward systems cause managers to miss opportunities to control and improve basic production and service processes.

It also describes the basic methodology for using the principles correctly and provides examples of successfully implementing modern systems in mining - to achieve higher productivity.

INTRODUCTION - PROVEN SUCCESS

The improvement in underground development rates at a progressive client's mine within just one and a half months of starting to implement the principles described in this paper - and after successfully completing only the first step in a seven step process of performance improvement is shown in Fig. 1

Seven months after starting implementation and after completing just the first three steps, the sustained improvement in productivity was over 50% - with reduced capital equipment!

Around the world, operations using the principles have reported sustained productivity improvements of up to 100% and cost savings of as much as 50% - without additional capital investment.

Improving productivity boils down to:

- identifying *what* to change using modern correct Measurement, Analysis and Reporting systems,
- applying a systematic *methodology* for improving operating and commercial processes,
- changing people's *behaviours* and attitudes - to build a new culture for ongoing improvement

In many businesses, all three actions are flawed. Even managers' attempts to change people's work practices fail simply because their methods ignore the basics of human behaviour.

This paper will cover the first and third topics after briefly examining the fundamentals for improving productivity.

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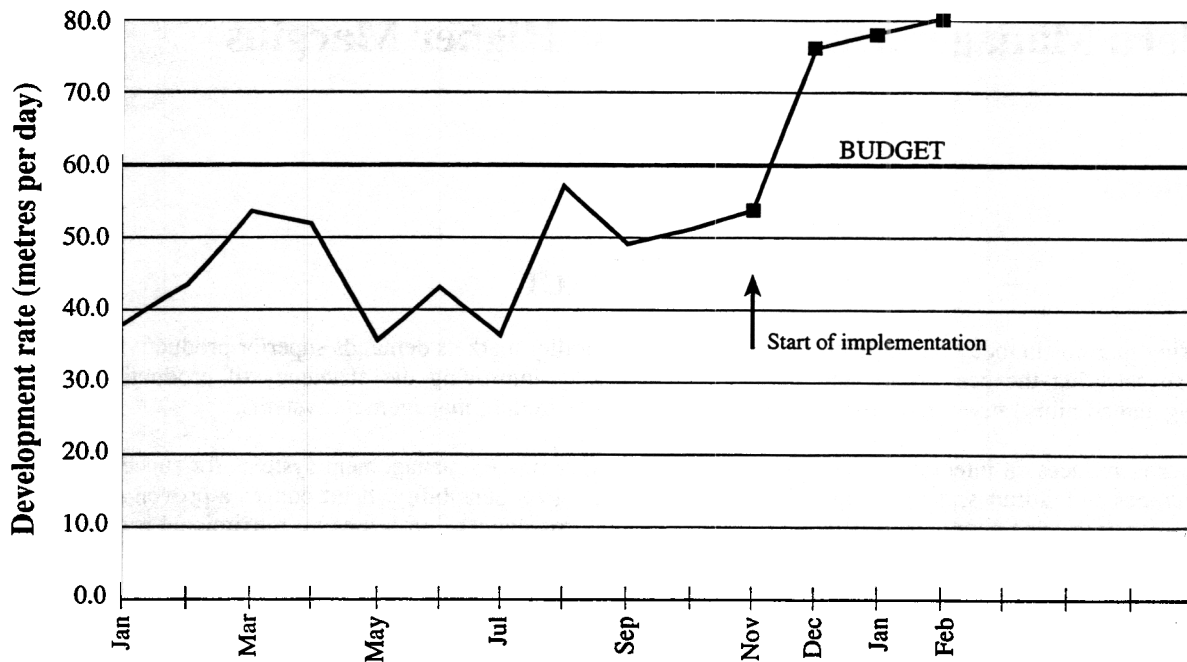


FIG. 1 Initial productivity improvement

FUNDAMENTALS FOR IMPROVING PRODUCTIVITY

Before examining why many managers and executives fail to achieve lasting significant changes in work and management practices, please consider the following brief yet important note. Many managers state obvious agreement with this note yet unfortunately their systems often prevent them from complying with it.

To improve results, first improve processes!

A process is defined as a series of (usually) repeatable tasks. There is a wide variety of production, commercial, marketing and administrative processes in mining.

An obvious example is the breakage of rock in underground roadway development and production faces. In these processes, outcomes are measured in metres or tonnes together with dollars and coal quality. Coal preparation processes also have outcomes with similar measures.

Other less obvious but important examples include processes for relocating production mining faces (and their equipment) and processes for providing maintenance, clerical, marketing and commercial services. Such processes have outcomes measured in time, dollars and work quality.

A less tangible but very important example includes management processes such as planning where outcomes are measured in speed and quality of making decisions and providing information.

To improve organisational performance, the first fundamental is to think in terms of processes. Overall business margins do not improve through needless or wasteful investment in higher capacity capital, slashing indiscriminately at cost structures, wishing or simply shouting for better performance. Sustained improvement in margins requires sustained changes to the processes that produce the results. It requires process thinking.

Further, it requires an holistic approach over the whole organisation - the overall process.

Now, let's discuss why many managers fail to achieve changes in work practices.

Why the common approach to managing change fails

Managers of business need to lead people to change work practices and attitudes to improve productivity, quality, reliability - to maximise margins and minimise risk. This is a universal challenge faced by managers and executives.

The combination of behaviours and attitudes and to a lesser extent symbols defines culture. Workplace culture (including management culture) is the greatest determinant of business performance.

The common approach to changing attitudes and behaviour is to simply provide training and communication alone. Managers hope that such effort aimed at changing attitudes will then lead to changes in work practices. Fig. 2.



FIG. 2 Common approach to managing change

This concept is not correct - and wastes valuable management time and effort. Instead, the reverse is true. ie, humans change attitudes to align with behaviours.

Consider how humans develop attitudes toward the world around them. People develop attitudes based on their personal experience and in particular based on aligning their attitudes to be consistent with what they actually do - their actions. Fig. 3.



FIG. 3 Human behaviour

SYSTEMS DRIVE BEHAVIOUR

Hence, the key to developing new attitudes is to provide managers and operators with new actions - new experience - by changing what they do. By changing people's work and associated actions. This is achieved simply by changing systems that drive behaviour (Fig. 4).

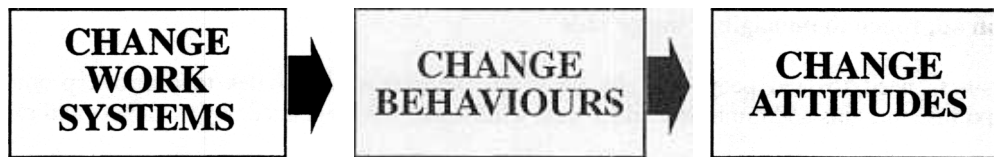


FIG. 4 Successfully managing change

Dramatic changes in attitude will then follow. Mackay (1994) provides a good, concise summary of this in everyday terms and Brown (1954) provides solid material to further describe the social behaviour of people at work.

A system is defined as a combination of procedures, equipment, people, policies and/or values that drives people's behaviour. It may be formally recognised and documented or informal. ie, within an organisation, a system is anything that drives ways of doing things. To change behaviour, managers must first change the systems in which people work. Managers need to provide systems that drive the desired behaviour.

Far from being the most difficult step, this is actually the simplest step - providing there is a basic operating philosophy to guide management. And providing management uses Measurement, Analysis and Reporting systems that drive teamwork and focus on learning about outputs and the processes that produced the outputs.

Modern management systems

Changing people's actions can be relatively simple. By far the greatest driver of human behaviour at work is the Measurement, Analysis and Reporting system. This establishes what is seen by people to be important and demonstrates the results of their efforts. It becomes the target on the wall toward which people work.

Unfortunately, as explained below, most businesses use Measurement, Analysis and Reporting systems that mislead people and drive sub-optimal and even counterproductive behaviours particularly among managers.

Fortunately Measurement, Analysis and Reporting systems can be changed unilaterally, simply and easily to drive desired behaviours.

At the other extreme, changes to pay systems usually need considerable discussion and usually negotiation. Such changes can sometimes be made quickly. More often they need to be made in stages. Regardless, even though remuneration systems are generally the second most powerful drivers of behaviour few remuneration systems drive behaviours aligned with the business' goals. Indeed, many pay systems drive behaviours that are counterproductive.

Between these two extremes lies organisation structure. While managers have the prerogative to change structures unilaterally, development and implementation of the optimal structure often requires consultation which needs investment of management time and effort.

One North American client immediately lifted core process availability from 85% to 89%, simply by changing its organisation structure away from the traditional departmental structure to one based on processes. The client quickly started reaping additional major ongoing benefits in higher morale and pride as operators, mechanics and managers worked together. Additional benefits are coming from increased ore recoveries estimated to be worth \$2,000,000 plus lower costs.

Ten key systems for driving behaviour:

- performance measurement, analysis and reporting
- organisation structure;
- management processes (planning, communicating);
- personal development and performance feedback;

- remuneration;
- accounting, budgeting and forecasting;
- core and service work processes and standards;
- general communication systems and processes;
- systematic ongoing involvement and recognition of people; and
- methodology for improving processes.

Other systems for driving behaviour include:

- safety management systems;
- planning and design;
- promotion; and
- selection and preparation (recruiting).

Additional systems are listed in Roberts (1995).

It is amazingly easy to change people's attitudes once the fundamentals are introduced correctly and behaviours are driven on-the-job with consistent, integrated systems.

As a mine manager, general manager and now as an external resource, the author has initiated and witnessed simple changes in management systems that have led to dramatic changes in management attitudes and significant increases in accountability.

The importance of correctly designing management and work systems to ensure effective culture change is detailed by Roberts (1995). To successfully manage change, do not focus on attitudes. Focus on behaviours - and change the systems

The paper will next examine broadly the most powerful system for driving behaviour and building attitudes.

Accurately identifying what to change

By far the most powerful driver of behaviour and attitudes is the performance Measurement, Analysis and Reporting system. It determines what becomes people's targets and is usually far more powerful than pay systems.

Broadly, the two main purposes of measuring and analysing processes and businesses are:

- improving processes - identifying accurately what to change and assessing the effectiveness of changes;
- understanding performance levels relative to targets (whether imposed by markets or internal budgets)

In this section the focus will be on improving processes.

Variation is a law of nature

There is variation in all dimensions, objects and tasks. No two people are identical. No two cars off the same assembly line will have exactly the same panel gaps even though from the same process. No individual or team will install roof bolts in identical times on every occasion. No two loads of ore will be trucked from face to crusher in exactly the same time. No two loads of coal will have exactly the same ash content when fed into the preparation plant. Variation occurs in everything.

Hence, the outputs from a process will vary even if the process remains unchanged. Such variation is known as natural variation. To react to each such variation by allocating resources or changing the process in reaction to each output point is obviously foolish and counterproductive. Yet this is exactly the behaviour that traditional measurement systems encourage.

Society's Poor Understanding of Variation

Traditional Measurement, Analysis and Reporting systems lack understanding of variation. In traditional systems, work processes and their performance are assessed merely by comparing the latest output data point to a target/budget, or to the previous data point or to the average output. This reinforces poor understanding of variation - and leads to poor understanding of the process itself.

Decisions are commonly made as a reaction to the location of only the last data point.

Fig. 5 shows a headline and graph from a supposedly reputable finance and business journal. The graph shows the "last data point" evidence used to justify an article implying the economy was slumping - at a time when the economy was clearly in full recovery. The incorrect analysis and conclusion reflected in the erroneous headline were based on comparing the last two data points - "O" and "N"! Yet the reader will quickly see the error by simply examining the graph visually.

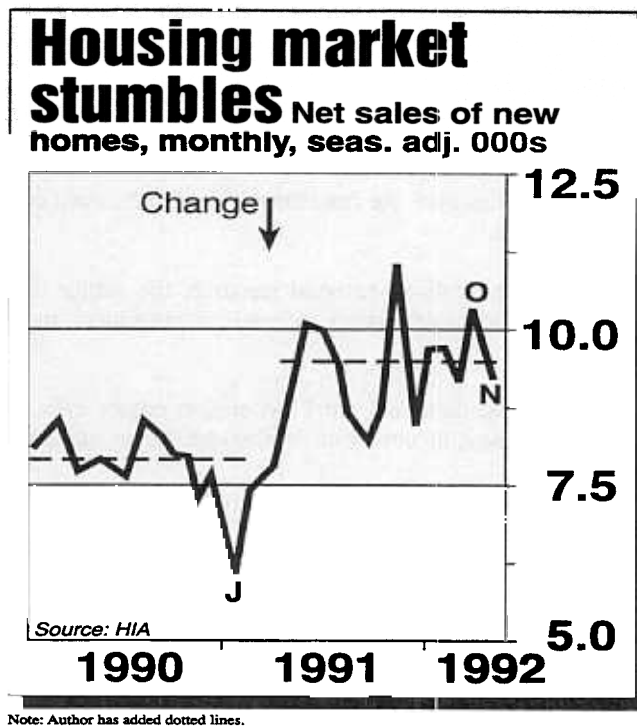


FIG. 5 Poor understanding of variation

Traditional managerial and business analysis leads to many such errors. A quick glance at the graph shows there are two different "processes" for selling houses. The first portion of the run chart shows results during an economic recession while the second portion shows a dramatic and sustained recovery in sales. This shows a change in the process!

The two dashed lines added by the author highlight the change. Note that within both periods there is monthly variation due to natural variation.

Similarly, output (such as production, safety, quality and cost) will vary. Managers must not make incorrect conclusions from natural variation. After all, who would expect to sell exactly the same number of houses every month?

The headline's poor understanding of variation is representative of management systems guiding managers to operate businesses and manage processes by drawing conclusions based merely on the last data point output.

It is not just the use of graphs that is important. It is the graphical presentation and the analysis of data using an accurate understanding of variation.

Fig. 6 shows a change to an actual mining process. The change was missed by site operations managers and corporate executives using traditional analysis systems based on relatively few data points. This obscured the real improvement and prevented the changes from being identified and locked into place. Instead they were lost from the business!

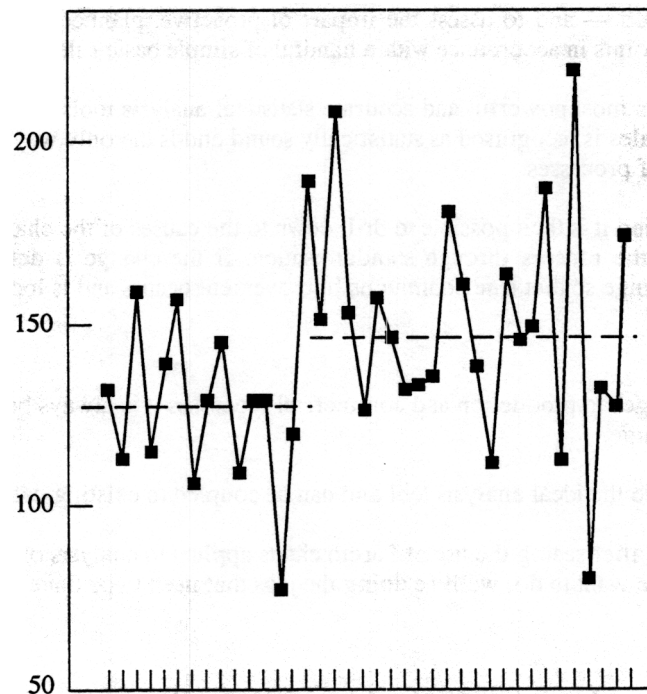


FIG. 6 Identification of a process improvement

Simply graphing their existing data and merely eyeballing the run chart of process output data using an understanding of simple rules for analysing variation makes the improvement obvious.

How many such improvements in industry are not detected and therefore not locked into the process and thus lost? How many drops in performance are not detected and therefore not identified and locked out of the process and thus continue to suppress performance?

Many!

Budgets are not Process Improvement Tools

Traditional measurement systems are characterised by reliance on comparison with budget and the use of tables. Such systems are valid only for assessing performance relative to targets.

While they can usually identify that something needs to be done they cannot identify what to change in a process.

Used alone as is the case by many managers, the use of budgets as process improvement tools leads not to focusing on root causes but to suboptimal management decisions and behaviours, finger pointing and creative excuses. This wastes resources and undermines management's authority and reduces discipline!

Budgets are important planning tools and scoreboards. They are not process improvement tools.

Contrast this with the use of modern, accurate analysis provided by run charts, Pareto charts and cycle time charts in the hands of managers who understand the simple yet powerful principles for understanding variation to make accurate decisions!

Run charts, Pareto charts and cycle time charts are just three of many simple yet solid graphical tools for unearthing precious knowledge immediately - and for accurately forecasting and improving process behaviour.

Run charts

Leading businesses use run charts (Fig. 6) to enable managers to accurately and quickly identify significant points indicating a process has changed — and to assess the impact of proactive, planned changes. This involves plotting and analysing process output data points in accordance with a handful of simple basic rules.

The human eyes are the world's most powerful and accurate statistical analysis tools. Eyeballing in accordance with basic statistically sound and simple rules is recognised as statistically sound and is the only way to accurately and simply analyse data to obtain real knowledge of processes.

Once a change has been identified it is then possible to drill down to the causes of the change. If the change is beneficial, it is captured by locking it into the process through standardisation. If the change is detrimental, it is locked out of the process. And so on for each change so that true continuous improvement occurs and is locked in.

Pareto charts

When proactively making changes to production and commercial processes it is always best to first make accurate analysis before determining what to change.

Pareto charts (eg. Fig. 7) provide the ideal analysis tool and can be coupled to existing data bases with minimal effort.

As stated by a client's manager after seeing the use of Pareto charts applied to analysis of production delays, "from now on we won't be picking the jobs we want to do, we'll be doing the jobs that need to be done"!

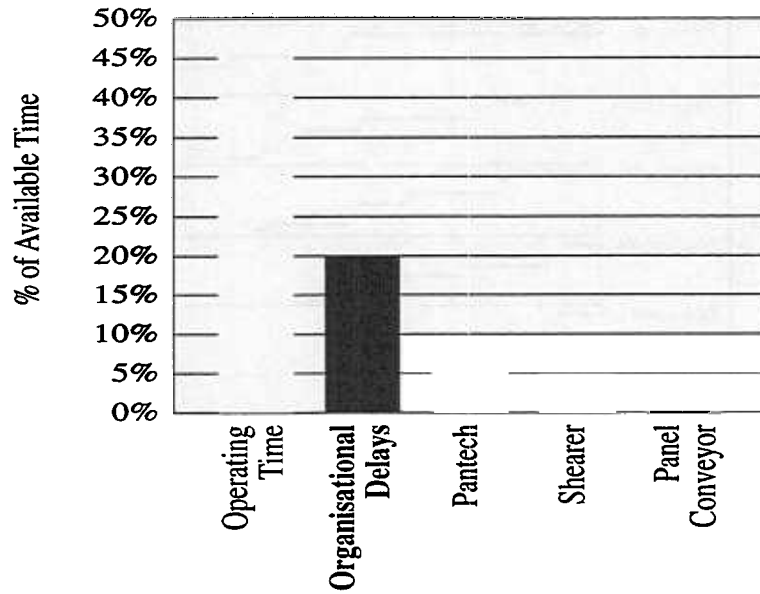
Cycle time charts

Fig. 8 shows actual improvement of cycle times in development of an underground coal mine's roadways. At 20 days the first pillar development cycle was lengthy. Successive improvements reduced cycle time dramatically by standardising work methods. Once the process was stabilised and in tight control it was then possible to attack the sub-processes and productivity components. Modern analysis methods were being used at the mine to direct and monitor progress - to lead.

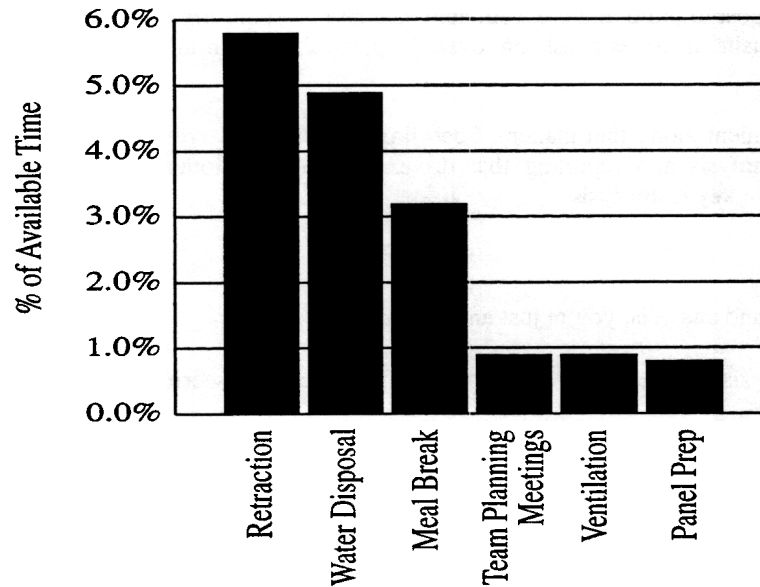
Contrast this with a commonly used measure of drivage rates in mines - metres/shift. This focuses on maximising individual shift performance and leads to sub-optimisation. Instead, in reality, drivage depends on the performance of all shifts and departments interacting around the clock.

Additional benefits of using cycle time charts include leading people to improve planning and to perform as many activities as possible simultaneously - in parallel. Cycle time charts move people's focus from just current tasks to the whole cycle. They communicate process improvement graphically and quickly. This builds work satisfaction and pride of achievement. Cycle time charts also provide direct indication of waste - the longer the cycle the greater the waste.

Available Time Pareto Analysis



Organisational Delays Pareto Analysis



(Data has been truncated to maintain confidentiality and ensure brevity)

FIG. 7 Pareto chart for systematic improvement

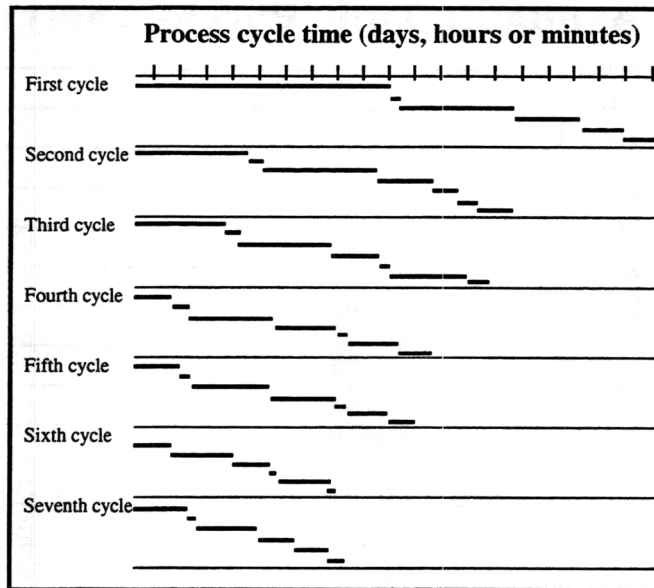


FIG. 8 Cycle time chart

FRAMEWORK FOR EFFECTIVE ANALYSIS

Many organisations are wasting valuable management time in collecting unnecessary data and in neglecting analysis. Such businesses have lots of data yet lack knowledge and understanding of processes!

It is simple, easy and low in cost to build and use a suitable database or to modify most existing databases to provide solid analysis. The main prerequisite is to establish an overall approach to minimise the volume of data and maximise knowledge.

Remember, it's not measurement alone that matters. Such limited thinking drives counterproductive behaviour. Instead, it's measurement, **sound analysis** and reporting that drives correct behaviours. In process monitoring and business performance improvement **the key is analysis**.

Consider two facts:

- without data and sound analysis, you're just another opinion!; and
- Measurement, Analysis and Reporting systems are by far the most powerful drivers of behaviour and culture

For additional information please refer to Wheeler (1992, 1993), Deming (1986) and Roberts (1995).

The importance of controlling variation to understand the process and identify opportunities leads to putting the business and process knowledge to use in a disciplined, efficient and effective method for improving performance.

PROVEN METHODOLOGY FOR IMPROVING PRODUCTIVITY

It is easy to tickle up performance with immediate changes. To sustain and then continually improve performance though managers need to first get tight control of processes.

The methodology for improving performance is based on these broad steps:

- define the process
- modify management systems to support the process and drive desired behaviours
- get control of the process, then,
- raise the level of performance by attacking the productivity components:
 - hours of production time
 - production rates per hour
 - resource allocation and utilisation
- Then continually improve the process

This broad outline forms the basis of the proven seven-step methodology for improving processes which unfortunately beyond the scope of this paper.

The methodology is based on the fact that wastage of resources increases (and decreases) as variation increases (and decreases). This fundamental is now proven in commercial, production, marketing and administrative processes world-wide. It has been explained in theory by Taguchi in Deming (1986). The relationship between variation and wastage of resources is detailed in Roberts (1995).

It is particularly important in mining and agricultural processes which obviously deal with more highly variable input than do processes in manufacturing and service sectors.

Reducing variation provides two immediate benefits:

1. increased managerial control of processes; and
2. reduced wastage of productive resources for higher performance.

Return to Fig. 1 which shows the impact of reducing natural variation by standardising the mining processes. The reason is simple. As variation decreases, the wastage of resources such as labour, ideas, time, money, capital and materials decreases! Processes with lower variation are also easier to manage and to improve. Planning is more effective and work easier - and thus safer and more productive!

Managers and their people have greater control over their work processes.

Mining examples highlighting the increase of wastage with variation are provided in Roberts (1995).

(There is also an internationally known methodology that applies at the micro-level of process improvement and enables systematic assessment, implementation and standardisation of new ideas and suggestions. This Plan-Do-Learn-Act loop is tied to the overall seven-step performance improvement methodology.)

Remember though that the control of variation and processes begins with accurate measurement and analysis of variation!

The benefits in accountability, discipline, safety, metreage, tonnage, throughput, yield, recovery, product purity/quality, total cost and unit cost in mines and prep plants go straight to the bottom line.

Strategic Aspects of Putting it to Work - Solid Overall Plan

To ensure the development of all systems drives consistent behaviour, managers need to build and implement an overall plan for changing systems. An example is provided in Fig. 9. This requires and provides a strategic, holistic approach over the whole business.

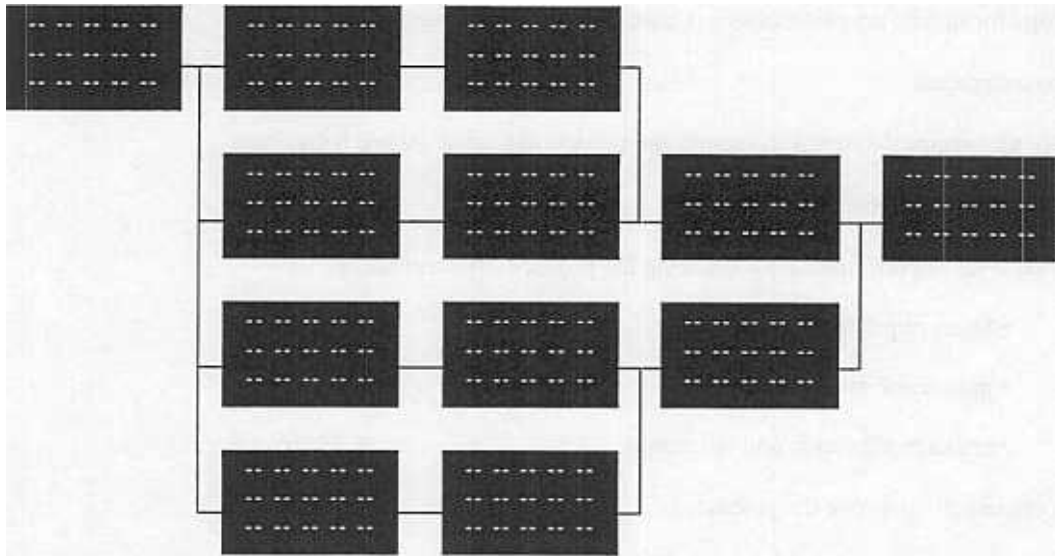


FIG. 9 Strategic plan for successfully changing systems to drive desired behaviours

This also has benefits in showing each manager his part and responsibilities in changing systems and displaying clearly the dependence of other managers on his/her effort. It is highly effective in communicating change and instilling confidence in people at all levels that management knows where it is going. Significantly, it is extremely useful in reducing uncertainty - and after all people do not dislike change they dislike uncertainty.

Obviously the most powerful driver of behaviour must be one of the first systems to build - the performance Measurement, Analysis and Reporting system.

PRACTICAL IMPLEMENTATION IN MINING

Ideally, implementation starts at "the top". Concepts are introduced and systems are built at senior corporate management level and then progressively down through the organisation structure to the people in the core processes of each production, commercial and marketing department.

Where there is need for immediate performance improvements it may be necessary in practice to first build and implement basic systems at the management level which makes daily operational decisions. In such instances implementation should then proceed quickly up and down the organisation. Fig. 10

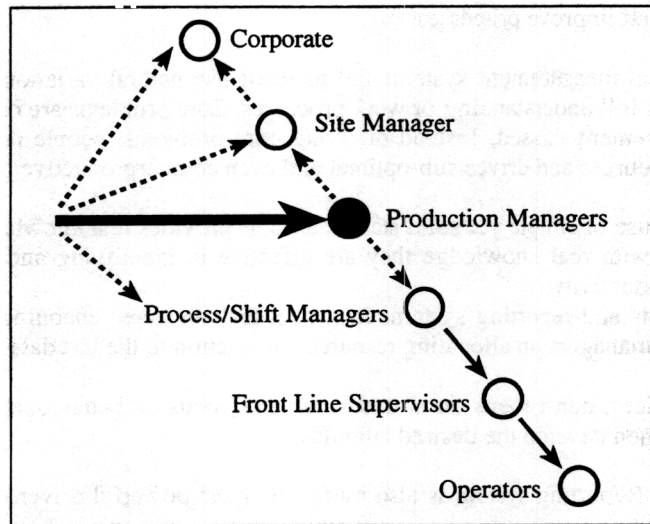


FIG. 10 Implementation sequence for rapid improvements

Where senior management is not committed to the way of working, this second implementation sequence has higher risk than with starting at the top.

Thus, the starting point depends on balancing the client management's immediate and long-term needs, skills and commitment.

Never commence implementation with the operators. Unfortunately this is where many attempts to implement the principles start - and therefore fail. While it's easy to start at the face and "tickle-up" performance, the improvements will not be sustained.

For higher performance to be sustained, appropriate supporting management systems must be in place.

Managers who try to start implementation at the operator level often do so because they mistakenly think the concepts are merely a human resources initiative and a bag of process improvement tools for operators. Such managers fail to fully understand the principles. Implementation traps are detailed in Roberts (1995).

In improving businesses there is rarely a need for extensive training or lengthy, expensive strategic analysis. Most organisations already contain the necessary talent. It simply needs to be harnessed and united in a common way of working under appropriate and consistent modern management systems.

During execution of the plan it is important that in addition to understanding and using the overall steps, managers and operators are left with tools for continuing to improve productivity themselves as part of their ongoing daily work.

Above all, this is a strategic initiative. It is most leveraging at corporate and senior site management levels.

SUMMARY AND CONCLUSIONS

The proven principles discussed in this paper form a complete way of working, a template for best practice management systems, a methodology for improving processes and an integrated group of productivity improvement tools for continually improving processes and results.

This paper has focused on the Measurement, Analysis and Reporting systems and on the importance of systems in general for driving behaviours and attitudes.

Remember, to improve results, first improve processes.

Secondly, people using traditional measurement systems fail to recognise natural variation and cannot correctly analyse business processes. This prevents full understanding of work processes. Core problems are often not identified and thus the biggest opportunities for improvement missed. Instead of fixing core problems, people react to the last data point and chase symptoms. This wastes resources and drives sub-optimal and even counterproductive behaviour.

A proven alternative exists. The use of simple yet solid statistical tools provides real knowledge about work processes and waste. When people are armed with real knowledge they are effective in identifying and killing waste using a proven methodology for maximising productivity.

Do current measurement, analysis and reporting systems in the reader's business encourage real understanding of work processes? Or, do systems focus managers on allocating resources in reaction to the last data point?

Thirdly, in changing work practices, don't focus on attitudes. Instead, focus on behaviours. Build systems that drive the desired behaviours - which will then develop the desired attitudes.

The Measurement, Analysis and Reporting system is also by far the most powerful driver of behaviour aligned with any organisation's business goals.

Pause and consider the formal and informal systems that currently drive people's way of doing things. What do current systems tell people? What behaviours do current systems foster in managers and their people?

Adopting this consistent way of working and using its proven methodology for process improvement will improve workplace cultures and optimise business processes to maximise productivity, margins and return on investment.

World best practice systems - isn't that what is wanted?

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