

## **8 HIGH LEVEL COMPARISON BETWEEN MINING AND MANUFACTURING**

### **8.1 INTRODUCTION**

In chapters 5-7 the content and characteristics of Total Quality Management, Just-in-Time and Theory of Constraints are discussed. Most of the theory, examples and case studies of these operational management philosophies are based on the manufacturing sector, whilst some refer to the services sector. It is therefore necessary to determine the differences between a mining and manufacturing environment before an operational management model for a mining production unit can be developed. The following paragraphs highlight the main differences.

### **8.2 PHYSICAL ENVIRONMENT**

#### **8.2.1 Static versus. Dynamic physical environment**

A manufacturing company has a static physical environment. Usually it consists of physical structures (workshops, warehouses, plants etc) and outside yards. Fluctuations in the weather (rain, heat, wind) can influence outside operations, but normally inside operations will continue as before.

The situation in an underground coal mining unit is vastly different. There are physical structures above-ground (administrative buildings, workshops etc.) but the "manufacturing" of the product takes place underground where the environment is constantly changing. Because of the production process new ground is opened every day, changing the physical environment. Outside weather variations has an impact on the conditions underground, as it directly impacts temperature, gas build up etc. The physical environment is taken into account in the planning process in a mining company.

### **8.2.2 Safety hazards**

In a manufacturing environment the production equipment and /or the products, assert a safety or health risk. This differs from the mining environment where not only the production equipment and product, but also the environment poses a hazard. Gas and / or coal dust explosions, roof falls and flooding are constant factors that need to be addressed, managed and planned for.

### **8.2.3 Expanding versus fixed physical environment**

In a manufacturing company the size of the work area stay fixed. It only changes with new expansions or changed layouts. In an underground coal mining operation a section can advance an average of 30 m per shift. Taking into account that there can be 5-10 sections per mine, this constitutes a rapidly expanding mine. Some sections do pillar extraction <sup>1</sup>, in effect reducing the mine area. Very accurate and up to date mine planning is needed to cope with this constant changing environment.

## **8.3 INVENTORY**

### **8.3.1 Raw material**

In a manufacturing company raw material is normally acquired from an outside supplier. Large procurement departments, warehouses and internal logistic systems are needed to manage the inventory. The stock levels of inventory and release strategy play an important role in the total production process.

In the mining production unit the raw material is already there. It does not need to be bought or transported to the beginning of the work stream. It does not have a price, except for the purchase price of the initial mineral rights. The stock levels are high enough to never have a problem with delivery. Releasing the material only depends on production planning. A

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<sup>1</sup> During the normal pillar & board coal extraction process blocks of coal are left over while advancing, for roof support purposes. At the end of a viable block of coal, the section retreats, using pillar extraction as a method of reclaiming the blocks of coal left over. This causes the roof to fall behind the section, closing that part of the mine totally.

problem that can only partly be managed is that of the quality of coal. The inherent quality (inorganic content etc.) and other factors influencing the quality (dolerite intrusions, burnt coal) of coal can be predicted with different geological explorations. However, it is very difficult to achieve a high accuracy and is costly. The production team does have an influence on the quality of coal. Not cutting into the roof or floor and not loading metal and other scrap onto the belts can reduce the contamination. There are also various actions they can take to reduce the fine coal percentage.

An interesting observation is that in a manufacturing environment the raw material moves through the (fixed) first work station, and further along the production line. In a coal mine the raw material is fixed and the first workstation (continuous miner) moves through it.

### **8.3.2 Work-in-process**

Work-in-process (WIP) in a manufacturing plant consists of the raw material going through different workstations and constantly changing form or characteristics. A combination of different raw materials is assembled and the final product looks different from the input materials. Buffers are used between workstations for various reasons, e.g. to protect the bottleneck, to hide inefficiencies, etc.

WIP in a coal mine is in essence the feedstock coal, mined from the coal face, crushed to smaller pieces, which are transported from the production section to the bunker. Underground it does not have as much value as when it lies on a stockpile, screened and blended. Value is also added by beneficiating it to differentiate between different grades of coal. Buffers underground and on surface are in the form of bunkers, and they are there to protect the output of the mine (a serie system of conveyors) as well as to achieve a smooth flow of coal. For export coal stockpiles have the added advantage of reducing the total moisture content of the coal.

## **8.4 STRATEGIC PLACING**

Detail planning and research is needed to determine the best location for a specific plant. Market research, accessibility to transportation, distribution networks etc. play a role in determining where to base the plant. A mine is totally dependent on where the resources

are located. If it is 60 km into a desert or near a big city, that is where the mine will be placed. This places a strain, logistically and cost wise, on the mine to ensure that workers, spare parts, equipment, the final product etc. are transported to the different locations efficiently.

## **8.5 SUSTAINABILITY OF RESERVES**

A manufacturing company normally has more than one product line. The types of products and product mix can be changed according to market specifications and / or availability and accessibility of raw materials. A mining company is dependent on the reserves it has acquired. These reserves are not all of the same quality, and usually deteriorate the older the mine becomes (the main shaft is normally sunk at the spot with the best reserves). With increased productivity (necessary to stay competitive) the mine life decreases. New reserves need to be acquired for the company to stay in business. This can be difficult, as the resource pool is finite.

## **8.6 CONCLUSION**

A mining production environment differs substantially from a manufacturing or services environment. These differences will determine to what extent different operational management philosophies can be applied in a mining production unit.