DOWNTIME REDUCTION
A PROFITABLE ROAD TO SUCCESS

- PART 1 -
THE FINANCIAL IMPACT OF DOWNTIME REDUCTION

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With this series of 3 articles we hope to improve awareness in downtime reduction effects within production companies. To our knowledge the industry seems not enough aware of the financial impact this type of production improvement has. In 3 steps we will let the reader get familiar with our perception of downtime reduction:

1. *The financial impact of downtime reduction.*
2. *Gaining the essential data and the "Human sensor"*
3. *Results and corrective actions.*

We hope you will enjoy these articles.

1 Introduction

1.1 General

During the years of 1994 till 1996 S&S Systems and Rooij Consultancy studied the process of downtime reduction at a Dutch solid board manufacturer. At that time they noticed that paper and board producing companies not always perceived the positive impact of relatively small uptime increments on the profit of the company. During these years a prototype Management Information System (MIS) was developed to provide the management with vital information concerning downtime. Based on this information management can take appropriate measures to optimize the production process. Later, this prototype was rebuild as a professional system and installed at three machines.

It is striking to notice that still relatively few companies have taken adequate action to focus their attention more on actively increasing their uptime. On one hand this may be caused by the trend to start up all kind of cost reduction programs to increase shareholder value instead of focussing on profit increment, the actual goal of all stakeholders of the organization. On the other hand it might be caused by the enormous attention companies had to pay to inevitable events like the year 2000 problem and the introduction of the Euro. To overcome these events many companies invested heavily in deploying ERP-systems (Enterprise Resource Planning).
However in their vision to increase profit, currently more and more production organizations realize that investing in technology seldom automatically improves results as expected, but that improvement of the interaction between used technology and employees is the key to improve the organization and its results. In the presented process of downtime reduction this notion plays an important role.

The objective of this paper is to make producers more aware of the positive impact uptime increment has on the profit of the company. A concept for the process of downtime reduction is presented for the paper and board industry as an example. The S&S Systems downtime reduction method is currently accepted by other industries like the malting industry. In this respect special attention will be paid to the importance of the human factor. This concept can be a valuable addition to many production and maintenance concepts to close the gap between these 'theoretical' management concepts and the reality to execute downtime reduction at the work floor.

1.2 Downtime definition

From our research is known that within the (paper and board) industry a wide variety of downtime definitions are being used. This is not only confusing in discussions about this subject. It also makes downtime quantities of different companies incomparable. Here the following definition of downtime is used:

- Downtime = every minute (second) of the year no saleable product is produced.

Note that this definition not only includes machine failures, stoppages and commercial stops, but also production time in which non-saleable product is produced because of unacceptable quality deviations.

2 Goals and advantages of uptime increment

One of the ways for a factory to increase profit is increasing production through increasing uptime. This will not only increase profit when the extra production can be sold, but will also lead to some other unrestricted advantages.

2.1 Profit increment

Derived from a standard economic break-even analysis a straightforward model is developed to estimate the financial impact of uptime increment for a single paper board machine. Based on simple rules this model calculates the financial profit that results from selling extra production realized by the increased availability of production time. Other financial advantages of downtime reduction are excluded for simplicity. These other advantages will be mentioned in the next paragraph.

As an example the case is studied in which downtime on a single machine is reduced from 15% to 14%. The machine has an annual output of 100.000 tonnes solid board/paper. Other parameters are given in table 1.

Situation:		**A**		**B**		**Difference**
Downtime	[%]	15%	**→ reduction →** (see financial model)	14%		- 1%-point (-6,75% abs)
Turnover	[€/tonne]	500		506		+ 6
Fixed costs	[€/tonne]	300		300		0
Variable costs	[€/tonne]	150		152		+ 2
Profit	**[€/tonne]**	**50**		**54**	**→ result →**	**+ 4 (= +8,2%)**

Table 1: Example of impact of downtime reduction on profit

Turnover	500 ← Input					
Fixed costs	300 ← Input					
Variable costs	150 ← Input					
Current downtime [%]	15 ← Input					
Reduction downtime [%-points]		1.0%	2.0%	3.0%	4.0%	5.0%
Profit increment [%]		8.2%	16.5%	24.7%	32.9%	41.2%
Downtime [%]	15.0%	14.0%	13.0%	12.0%	11.0%	10.0%
Uptime [%]	85.0%	86.0%	87.0%	88.0%	89.0%	90.0%
Turnover	500	506	512	518	524	529
Costs						
Fixed	300	300	300	300	300	300
Variable	150	152	154	155	157	159
Profit	50	54	58	62	66	71
Profit increment [abs]		4	8	12	16	21

Figure 1: Part of the financial model (accessible via www.s-s-systems.nl)

Figure 1 shows the financial model for this case. The most important formula's used in this model are:

$$NewTurnover = \left(\frac{OldTurnover}{OldUptime}\right) * NewUptime \quad \text{and:} \quad NewVarCost = \left(\frac{OldVarCost}{OldUptime}\right) * NewUptime$$

On condition that the extra production in this example is sold against the normal price, the profit increases with:

$$NewTurnover * Extra\ Profit/Tonne = \left(\frac{OldTurnover}{OldUptime}\right) * NewUptime = \frac{100.000\ tonnes}{85} * 86 * 4\ euro = 404.706,-\ euro$$

From the model (and reasoning) can be concluded that the increase in profit is especially strong in situations where the ratio between fixed and variable costs is high. The graph in figure 2 visualizes this effect. Table 2 is used as input (original profit is 10% of turnover):

Situation	Fixed costs [%]	Variable costs [%]	Ratio fixed:variable costs		Profit increase [%]	Profit increase [€/tonne]
1.	33	67	0,5		4,7%	2
2.	50	50	1	→ model →	6,5%	3
3.	67	33	2	1%-point reduction in downtime	8,2%	4

Table2: Influence of the ratio of the fixed and variable cost on the profit increase

Using these typical cost structures and a profit margin of 10% as input for the financial model, the resulting profit increment approximately varies between 4,7% and 8,2% for every percent point downtime decreases (approximately € 2,- till € 4,- per tonne).

Do not hesitate to calculate the profit increase for your process(es) with this model. You can use or download it for free on our website: www.s-s-systems.com

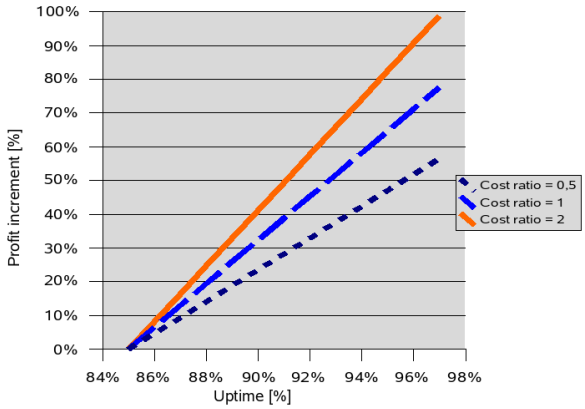

Figure 2: Profit increment related to increasing uptime

2.2 Other advantages

For many companies the profit increasing effect of downtime reduction will probably be the main reason to take measures to realize this. Besides this, a few other advantages can be realized at the same time and will even be realized when the freed production capacity cannot contribute to a higher turnover and profit because of commercial reasons. These advantages are mentioned in table 3.

Advantage	Explanation
Higher availability	Available capacity is closer to the designed / theoretical capacity.
More stable production process	Less failure will improve the stability of the process.
Planning improvement	A more stable process will improve the predictability of that process. The better predictable the better the (production and maintenance) planning can be.
General process knowledge increase	When it is clear to everybody what the main problems are and the main goal is, people are more willing to think and discuss about root causes and possible solutions. These discussions will increase the knowledge about the process and will lead quicker to solutions.
Product quality improvement	Fewer disturbances in the process give less variation in product quality and reduce poor quality costs.
Less energy consumption	Less energy is wasted on refuse and reject.
	Less energy is wasted when all stoppages are concentrated to one single stop, e.g. less heat is lost.
Better organization	Frequent unambiguous analysis of solid and up-to date downtime data in which everybody has trust, not only supports the organization in recognizing the main problems and prioritizing these, but also prevents needless discussions about bottlenecks in the process. This gives the organization rest. The time and mental energy saved can be spent on finding root causes and possible solutions.

Table 3: Other advantages of downtime reduction

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In part 2 we will present the philosophy of downtime reduction and how to gain the necessary data. In part 3 we will convert the gained data into clear objective information and mention some conditions to take corrective actions leading to more uptime.

About the authors

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Graduated as a Mechanical Engineer (production technology) at Twente University (The Netherlands). Early nineties he worked as an internal advisor within a solid board mill of KNP BT. Since 1996 he owns a consultancy company (Rooij Consultancy) with services in the area of Business Process Improvement and quality- and knowledge management. The principle for downtime reduction described in this article is one of his mental children. He was the main author of the paper from which this article originated. Today he delivers an invaluable contribution to the development of the third generation downtime reduction software.
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