Continuous improvement management for mining companies

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Synopsis

Enterprises are faced with increasing economic competition and managers are obliged to look for methods that will ensure a competitive edge in their companies' markets. These methods include managerial concepts that employ common sense and are low cost. One of these approaches is the KAIZEN methodology, of Japanese origin; kaizen means continuous improvement (CI) when translated. A mining company, despite some of its idiosyncrasies, is just an enterprise where the application of KAIZEN can be advantageous.

The company investigated, OKD, is the only domestic producer of hard coal in the Czech Republic and operates four mines that produce 11 Mt of coal annually. The OKD management team opted for KAIZEN as their principal method of continuous quality improvement.

This paper suggests ideas for development and application of processes that provide for continuing improvement of production and management. The authors have taken the OKD Company to be their benchmark in the field of mining activities. The paper also focuses on possible difficulties accompanying the introduction of CI sustainable methods. Three years of application of CI methods has increased the income of the company by almost US$38.1 million, which provides a strong argument for continued application.

Keywords
KAIZEN, management, continuous improvement, mining enterprise.

Introduction

Mineral extraction and processing represents a common enterprise activity associated with specific risks. Mining enterprises are oriented by profit, capital valorization, maintaining market position, augmentation of company assets, and various other objectives (Vaněk *et al.*, 2011). Attaining prominent objectives in current market conditions, characterized by competition and change, is difficult if modern managerial methods are not applied (Zausková and Kusá, 2011). 'Modern' does not necessarily mean new; quality management was first introduced in the USA in about 1920 as a statistical tool for industrial production improvement (Mizuno, 1988). Furthermore, there are Deming tenets as well as PDCA principles that date back to the 1950s (Košturiak and Gregor, 1993) and are still applied by managers today.

There are many methods and approaches that managers can apply, therefore they must select wisely from all available options, despite current fashions or fads, while being open to new methods and approaches and constantly keeping their specific requirements in mind. Managers also play key roles in the implementation of continuous improvement (CI), as human resource utilization is predominantly a managerial challenge (Drucker, 1999). It is collaboration that kick-starts and sustains continuous change (Farris *et al.*, 2009; Langbert, 2000).

CI is crucial if intense market competition and low-cost operation exigency is to prevail. The global financial crisis and the related global recession have directly or indirectly afflicted the situation of many business enterprises in the Czech Republic, and the mining sector has been no exception. In many other countries worldwide, mining is a significant contributor to the economy (Nzimande and Chauke, 2012) and is subject to demand and supply inconsistencies and unfavourable price movements. No matter what the cause of decreased income, there is no doubt that managers must optimize production costs. (Erol *et al.*, 2011; Laperche *et al.*, 2011).

In such difficult conditions, a company can keep its market position only if CI is routinely implemented (Baaij *et al.*, 2004). It is the objective of this paper to create awareness around continuous improvement and illustrate approaches utilized by mining companies.

Continuous improvement of processes

In economic practice, two types of change or innovation are common; either a sudden, fundamental change that requires a large investment as well overcoming intrinsic

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apprehension, or a slow step-by-step change that is easily accepted and requires negligible investment (Bessant *et al.*, 1994; Zaušková and Domová, 2012).

A company must strive to produce better, cheaper goods and services in order to grow. In addition to this growth, it is also necessary to continuously improve (Drucker, 1999). In order to understand the CI process we return to the origin of the managerial concept named KAIZEN. In July 1950, W.E. Deming was invited to Japan to teach statistical quality control. Deming introduced the 'Deming Cycle', one of the crucial quality control tools for assuring CI in Japan (Imai, 1986). The meaning of the Deming Cycle (Figure 1), also known as PDCA (Plan-Do-Check-Act) cycle, is a basic principle of Total Quality Control (TQC) or Total Quality Management (TQM).

KAIZEN has been accepted as a lifelong philosophy by many Japanese managers and workers. It integrates earlier approaches like consumer orientation, TQC, QC circles, Kamban, Just-in-time, zero defect, small group activities *etc.* (Imai, 1986; Ortiz, 2010). In simple terms, KAIZEN is the application of a common-sense and low-cost approach.

The traditional Japanese approach to QC is managerially oriented (Imai, 1986) because the team is key to the process of CI and drives company culture and values (Langbert, 2000). The KAIZEN perspective requires all company staff, including workers and junior managers, to be positive that their contribution is taken seriously and their suggestions, if approved by expert opinion, are implemented (Anand *et al.*, 2009). Only such an inclusive approach can provide the contributions required to improve existing standards, prevent stagnation, and avoid subsequent relaxing of initiative (Farris *et al.*, 2009). In addition, KAIZEN also represents productivity improvement, TQC activities, QC circles, or labour relations (Imai, 1986).

- One stumbling block to implementing changes can be misgivings whether the change is acknowledged by the party involved
- The undisputed advantage of KAIZEN is that it builds on utilization of the standing resources and does not necessarily require investment (Bessant *et al.*, 1994).

Successful implementation requires a formal declaration and the modification of existing managerial methods. KAIZEN should not be applied uncritically as a blueprint of another experience, but should take the specific background and idiosyncrasies of the specific organization into account (Bessant *et al.*, 2011; Recht and Wilderom 1998; Nocco, 2005). It is obvious that KAIZEN must start with the managers themselves and then continue to be applied by all staff. It is based on changing overall thinking styles and behaviours (Langbert, 2000).

Continuous Improvement at OKD

The Upper Silesia Coal District, which covers 7000 km^2, is a major European coal district spanning two countries – Poland and the Czech Republic. The southern part of the district, about 1550 km^2, is called Ostrava-Karvina Coal District (Dopita and Aust, 1997). The mining company, OKD a.s. (a.s. – 'akciová společnost' – is equivalent of the British plc), is the only producer of hard coal in the Czech Republic and runs four deep mining collieries in this district. In 2010, the company sold 11.5 Mt of coal, taking the fifth position in the list of major producers of hard coal in Europe, and the sales income reached a level of US$1.68 billion in 2010. OKD is also the biggest employer in the Moravia-Silesia region, with 18 000 employees. The company operations are divided into internal organization units that include the respective collieries and one service centre.

OKD cares about its image as a socially responsible enterprise, and this is reflected in its staff care programmes, which include many employee benefits. Previously, employees could file innovation applications but there was no system in place to assess innovation potential and motivate staff.

The CI system, introduced to utilize the staff innovation potential to its maximum, was instituted by a new management structure in 2008. This generated a wave of innovation proposals that could be systematically and objectively assessed, and remunerated accordingly.

Management incorporated a CI department tasked to utilize the concept to its full potential. The CI management implementation was accelerated in 2009 by the establishment of a CI Manager at each of the four collieries. The CI Manager reports directly to the director of the colliery. Natural authorities with extensive practical experience were appointed and a special CI committee (consisting of the CEO, CAO, COO, CF and HRO, CI co-ordinator, and colliery director) was formed and convenes every month.

An information campaign in the company's weekly, *Horník* (Miner) informed the staff of the company's CI drive and was supplemented by CI seminars and wall posters. (Brodský, 2011)

The CI idea is supported by the provision of value and finance frameworks (Bessant *et al.*, 1994). The CI structure should be realized step-by-step, especially if no similar structure is in place. Time should be allowed for staff to absorb the change (Bessant *et al.*, 2001). Table I shows the schedule of the CI structure establishment from 2010–2012 and indicates activities that took place in 2013.

In OKD, two types of activities within the CI framework were observed. On the one hand, **innovation initiatives of individual employees** are monitored; the other emphasizes **optimizing team initiatives**.

To promote individual CI activity, individual employee motivation is especially necessary. The process based on individual people is quite simple, in contrast to the team

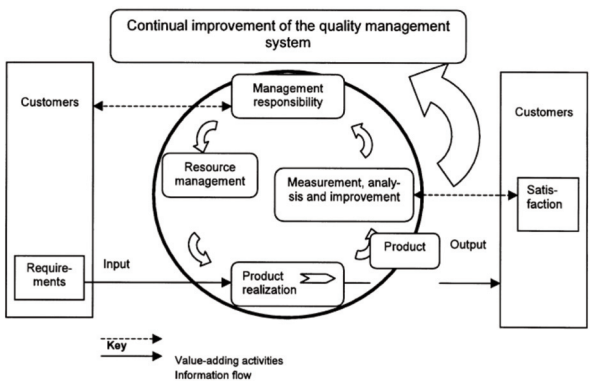


Figure 1—Deming cycle within TQM (source: ČSN EN ISO 9001)

Table I

CI structure establishment in the mining company OKD, 2010–2013

Stage	Year	Orientation	Specific content
1	2010	Individual CI	Activating creativity, individual involvement of managers and staff, employees of outsourcing companies working underground, provision of optimization teams and change alliances.
2	2011	Team CI	Team co-operation, filing group innovation applications, horizontal and vertical co-operation of management and staff – the project, *Moje firma* (My Company), internal consultancy activities.
3	2012	Process CI	Company macro-process autonomy (HR, material supply), removing bottlenecks of the critical macro-processes.
4	2013	CI custom fixation	Widening autonomy of macro-processes to safety, logistics, and coal face workings, gradual transition from volunteer to standard CI structures.

Source: OKD, original research

activity. A specialized external consultancy agency, HSG, was called in to conduct employee orientation in the newly established system and empower the teamwork activities. The project was titled '*Moje firma*' (My Company). The results of first year's team activities within the *Moje firma* project are displayed in Figure 2.

The consultant organized a training programme for colliery consultants so that they could employ their own expertise. Originally, only virtual training was involved, but the outcome was subsequently put into actuality by a team of CI managers. The internal consultants chose their own project, specific to their workplace conditions (HR management, work organization, technical problem solutions, economy, alternative or theoretical solutions, *etc.* and subject to authorization by the CI department and colliery director. The colliery director officially nominated leaders of individual project teams, assuring managers' support. After about six months, the results of these 'virtual' projects were presented to the consultants, HSG, and to all company managers. The assessment of the projects was made at a closed session. All participants were rewarded. The project outcome benefits differed – from hard financial gains through advantages difficult to express in numbers up to individual persons' experience with project management. Some projects were chosen as items of official optimization agenda; others were nominated to be the subject of long-term support and monitoring by internal consultants.

Generally the optimizing team's activities can be initiated by an individual worker, but they consist of well-thought-over, systematic activities in which staff participate and also include management and external consultants.

Both types of activities – individual innovative initiative and the optimizing team activities – will be clearly illustrated by taking an example of a specific CI management of a specific unit (colliery).

Tables II and III provide the results of the work of the CI department and all employees involved in the activity from 2010–2011. To show financial profit and rewards paid, the current exchange rate of 19.7 Czech crowns (CZK) per US dollar was used.

The results are slightly distorted due to differences of the assessment criteria provided for admission. For initial motivation the assessment criterion demands were set rather soft, and have been made stricter every year. The application of stricter criteria is substantiated because colliery resources are limited.

A methodical monitoring of the financial contributions of the innovations realized is conducted every 12 months. It is then taken to be an accepted standard and is reflected in related financial planning.

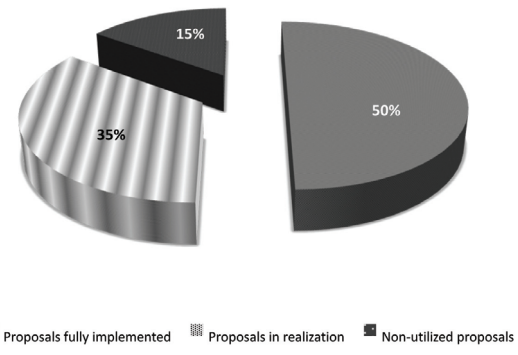


Figure 2—The results of the '*Moje firma*' (My Company) project (source: OKD, original research)

Table II

Statistics, CI OKD, 2010

	Filed	Accepted	Implemented	Financial profit, US$ million	Rewards paid, US$ million
Individual employee initiative	1 075	742	558	5.74	0.117
Specifically targeted projects of optimization	64	64	60	5.73	0.030
Total				11.47	0.147

Source: OKD Annual Report

Table III

Statistics, CI OKD, 2011

	Filed	Accepted	Implemented	Financial profit, US$ million	Rewards paid, USS million
Individual employee initiative	950	614	592	6.599	0.117
Specifically targeted projects of optimization	–	70	57	8.629	0.025
Total				15.228	0.142

Source: OKD Annual Report

Table IV

Annual change as a chain index, 2011/2010

	Filed	Accepted	Implemented	Financial profit	Rewards paid
Individual employee initiative	0.88	0.83	1.06	1.15	1.02
Specifically targeted projects of optimization	-	1.09	0.95	1.51	0.85
Total				1.33	0.98

Source: OKD Annual Report

Questions have been raised about the evaluation method for the innovations realized in practice. For example, innovations in the field of energy saving will generate benefits in the longer term.

The annual change in performance is shown in Table IV, and it is clear that frequency of admissions decreased by 17%. At first sight this decrease may seem to be a CI failure; however, during this period income increased by 15%. The reason for this positive result is the better quality innovation proposals filed and the speed of their realization, up from 75% in 2010 to 96% in 2011. In 2012, year-on-year realization of innovation proposals decreased (500 innovations admitted) but the financial income increased by US$10.15 million.

To assess the CI activities, profits were monitored (*FP*) per innovation realized (*RN*). Table V shows the development of this ratio in the period 2010–2011.

A decreasing trend is noted for team project optimization, which dropped by three projects in 2011; nevertheless, financial income increased by US$2.9 million. Tables III–V present figures for the initial two years, when the CI structures were first implemented. It is obvious that many employees used the opportunity to file proposals that concerned the most critical issues of their work methods and environment (Farris *et al.*, 2009), which resulted in a rapid increase in profit. It would not be realistic to expect a similar innovation boom in the following years. Therefore the decreasing innovation rate serves as an example of CI success (Bessant *et al.*, 1994) as the innovations realized in the framework of KAIZEN became a standard that will be further developed by continuing improvement initiative (Glover *et al.*, 2011).

In the long run, innovation opportunities will be less frequent and the CI initiatives will have to concentrate on diagnostics (Bessant *et al.*, 2001), and there will be less opportunity for cost optimization based on minimization. A kind of a *status quo* satisfaction may follow, which will require management to exert their influence to seek opportunities for further improvement or risk losing benefits gained from the CI effort.

CI method and tools, ČSM colliery

The mining company OKD consists of four collieries, each of which operates in different conditions. In KAIZEN terms, these are designated as *gemba* (Imai, 1997). The following section demonstrates specific tools and activities that are part of CI structures active at a specific colliery. The individual collieries differ for objective and subjective reasons, thus CI is approached differently. The global objective is dissemination of knowledge and positive staff experience.

Each colliery has its idiosyncratic position and each *gemba* must be considered individually. Our example *gemba*, the ČSM colliery, has 3300 employees and is considered the third largest in OKD. This model *gemba* demonstrates all the processes, tools, and activities studied.

ČSM colliery uses the following CI tools:

- Idea card (innovation proposal)
- Teams of optimization
- Analyses provided by CI department
- Education.

The ***idea card*** (Figure 2) serves the purpose of noting down employee proposals. The innovation idea is briefly identified and specified. The idea card is not essential to the innovation proposal submission, as informal applications are also acceptable and can be e-mailed, telephoned, or verbally communicated, in either Slovak or Polish. In the case of an informal application an idea card is filled in by a CI official and authorized by the innovation initiator.

The CI department registers the card, which is subsequently passed on to professional experts or supervisors of related activities. Several professionals assess the value of each innovation proposal.

Table V

Development of profit increase by innovation, 2010–2012

Year	2010	2011
FP/RN, US$	10 288	11 162

After evaluation, the idea is recommended for admission or rejection. A decision is made by the CI Committee, which comprises the colliery director, his deputies, and the manager of the colliery CI department. The committee is tasked with considering ideas for admission, and once an idea has been admitted, the committee is responsible for its realization.

Optimization teams are contracted by OKD or colliery management. The subject for optimization can be initiated by all parties. The CI department director nominates a team leader. An 'expert guarantor' and 'sponsor' are also nominated. The expert guarantor is a staff professional or an external consultant that coaches the team and ensures the innovation realization follows CI conventions. He warns the team if there is an emergency or *cul-de-sac* of the activities performed for legislative, financial, technical, or patent right reasons. The sponsor is a colliery manager. He is responsible for managing those activities at the colliery that relate to the innovation realization, and provides for organizational conditions and material means of implementing the innovation. The sponsor also plays the role of a team supervisor and communicates with the colliery management.

After the innovation has been admitted for implementation, the colliery director places an order for the project. The team leader chooses his collaborators. Team membership is voluntary, and team members are rewarded on the grounds of their individual contributions and roles within the team.

The sponsor assesses the work of the team according to the following criteria:

- Safety of work and health protection
- Improvement of working conditions and environment
- Ecological improvement
- Reduction in shift overheads (material and workforce cost savings)
- Reduced energy demands (electricity, heating, water, gas, fuel, *etc.*), IT and telecommunication costs, transportation costs, *etc.*
- Reduced material costs (material *per se*, spare parts, technical gases, oxygen, antifreeze, *etc.*)
- Improving production and functional parameters (useful economic life, breakdowns, *etc.*)
- Decreasing production losses (processing, deposition protection, *etc.*)
- Miscellaneous.

The key phase of the overall improvement process is represented by the analyses that are conducted by the CI department, namely:

- Timing – (workplace or work process monitoring)
- Work map provision
- Mathematical analyses
- Critical point identification
- Statistical analyses
- Special tasks.

Notwithstanding the fact that CI staff takes advantage of all analyses, the decisive diagnostics are workplace and work process time-demand monitoring. The results of time studies are visually represented by a process map (Figure 3). Feedback meetings and communication with shift-based staff are considered to be an integral part of the procedure, especially to drive the discussion around the source of problems and possible remedying action.

An independent CI unit, which uses accepted standards, provides for the timing. Their conclusions are taken as objective and obligatory, an important consideration for managers. The sense of the CI work is not repressive but provides for diagnostics. It is about identification of weak points, definition of an appropriate remedying action, and above all about 'inflaming' staff, persuading them about the significance of KAIZEN.

The last, but not least, criterion is **staff education**. Tasks cannot be completed without appropriate competence. It is also important to initiate thinking centred around work improvement possibilities and ways to put innovation in practice.

The colliery provides:

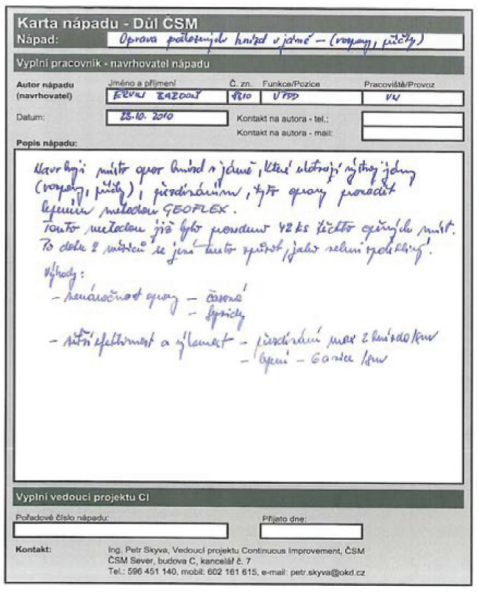
- Training – communication abilities
- Workshops – familiarity with analytical methods
- Training of internal consultants
- Managerial training, Manex – top management
- Manex practitioner – first line managers
- PC training courses
- Tailor-made courses and self-study
- Information and reference provision.

Conclusion

There can be no doubt that current technological standards are the consequence of revolutionary or incremental innovative processes in the long history of humankind.

The mining industry utilizes cutting-edge technologies characterized by developed segments of the economy. The difficult natural and market conditions in which mining enterprises operate require top-quality management that consider their own staff as sources of creativity.

We are quite positive that the decision to implement the KAIZEN concept is the right one, especially if a company wants to sustain their market position. OKD's successful operations support this argument; in three years the individual and collective optimization projects increased the company income by almost US$38 million.


Karta nápadu - Důl ČSM

Nápad:

Vyplní pracovník - navrhovatel nápadu

Autor nápadu (navrhovatel) | Jméno a příjmení | Č. zn. | Funkce/Pozice | Pracoviště/Provoz

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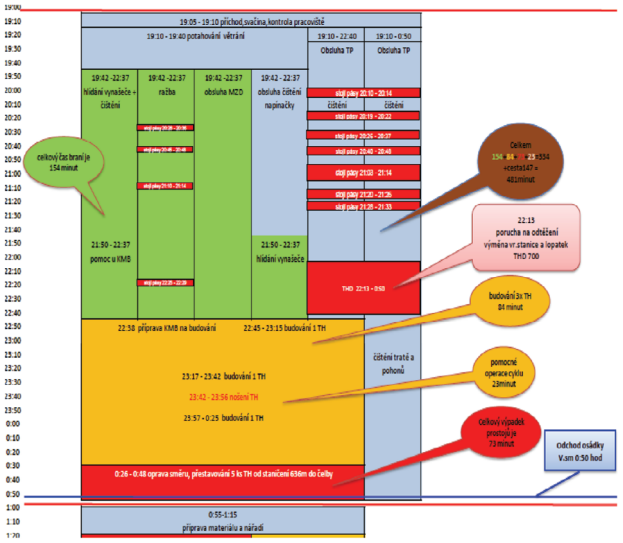
Figure 3—Idea card – Colliery, ČSM: rectification of nest damage in pit (source: OKD)



Source: CI department, colliery, ČSM

Figure 4—Process map example (source: CI department, ČSM colliery)

KAIZEN has a social and cultural background that is difficult for some people to adopt, but it is essential and intrinsic to the concept that all staff members participate in order to have the maximum impact. The company management of the *gemba* discussed here is well aware of this fact, and structures their remunerative schemes accordingly. One of their successful innovators can even win a new car.

Nevertheless, some attention should be drawn to a certain disproportion that can erode innovation activities of managers and staff in future. It follows from the Annual Reports of 2010–2012 that the company spent only US$0.289 million on innovation rewards, which is only 1.08% of the company's overall US$26.7 million income increase from improvement.

'Penny wise and pound foolish' policies do not work in the long run, considering the words of Peter Drucker: 'The most valuable assets of a 20th-century company were its production equipment. The most valuable asset of a 21st-century institution, whether business or non-business, will be its knowledge, workers and their productivity.'

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