Reinventing suggestion systems for continuous improvement

Roel W. Schuring

University of Twente/School of Management Studies , PO Box 217,
NL 7500 AE Enschede, The Netherlands
Fax: 31 53 4892159 E–mail: R.W.Schuring@sms.utwente.nl

Harald Luijten

Fokker Special Products, The Netherlands

Abstract: This article reports an experiment to increase the effectiveness of a suggestion system by deliberately applying principles of the *kaizen* and *performance management*. Design rules for suggestion systems are derived from these theories. The suggestion system that resulted differs from traditional suggestion systems in a number of aspects. For example, in the new system, line managers have a role in judging and rewarding ideas. All in all, the system has shorter lead-times, more focus on small improvements and does more to motivate participation. Also, it is demonstrated that the application of these design rules can lead to a considerable increase of the number and value of suggestions. A 'modernized' suggestion system is a core element for a continuously improving organization.

Keywords: *K a i z e n*; continuous improvement; suggestion systems; *performance management*; motivation.

Reference to this paper should be made as follows: Schuring, R.W. and Luijten, H. (2001) 'Reinventing suggestion systems for continuous improvement', *Int. J. Technology Management*, Vol. 22, No. 4, pp.359–372.

Biographical notes: Roel W. Schuring (1964) is Associate Professor of Management of Health Care Organizations at the University of Twente. His research approach is to enhance the understanding of organizations by studying the processes that take place. This approach serves as a basis for his research projects, such as the project that is reported here, which is one of his research projects related to continuous improvement. 1n 1999 he initiated a research program on health care management.

Harald Luijten (1971) has an MSc in Industrial Management. He graduated on the design of a suggestion system for Fokker Aerostructures. The current article reports the design and implementation of that system. Currently, he is head of the improvement group in one of the Fokker companies. Amongst his tasks are the implementation of Enterprise Resource Planning software and the (continuous) improvement of operations.

1 Introduction: the need for suggestion systems in a CI environment

Various approaches exist regarding the organization of processes of continuous improvement. Schroeder and Robinson [1] give examples of employee suggestion systems that date back to 1871 in the USA. Suggestion systems have a considerable history in Europe too. The employee suggestion system of Stork Boilers in the Netherlands has run just over a hundred years and still works. De Lange-Ros [2] provides an overview of approaches to continuous improvement. She shows that approaches with a role for specialists are prominent in practice, whilst approaches that emphasize participation of the shop-floor level get relatively much attention in improvement literature. Berger and Lindberg [3,p.94] conclude that many contemporary applications of suggestion systems "appear to be little more than an *ad hoc* approach with no intention to alter the fundamental for sustaining an improvement process in the organization". This is reflected in the effectiveness of most systems. Many suggestion systems deliver only relatively few ideas per operator per year. So, even though suggestion systems have a long and continuous history, we may wonder if the concept will play a more than marginal role in the future. We see two reasons to assume that suggestion systems will continue to be of central value to CI organizations.

The first reason is that it is difficult to catch the full potential of the relevant knowledge of employees about what could be improved in operations by use of team-approaches only. De Lange-Ros and Boer [4] demonstrate that CI in teams can be a difficult process, as there is a difference between the process of improving and the day-to-day operational process. As a consequence, coaches may need to devote a considerable amount of time to the teams. Also, our own experience suggests that the capacity and capabilities of teams of employees to perform improvement processes are limited. A central phenomenon is that groups can work out only a few ideas per unit of time, due to operational pressures. Furthermore, the capacity is limited as groups work relatively slowly, simply because communication and other group-processes take their own time. Also, group-wise improvement processes do not fully recognize individual creativity and energy. Especially if an individual has counter-intuitive suggestions, it might not be efficient if he or she needs to convince his or her fellow improvement-team members first.

A second reason is that Japanese systems for continuous improvement make use of individuals' suggestions in a very effective way. Schuring [5] illustrates the limited but nonetheless central role of operators in improving their work processes in such systems. Specialists and supervisors work out ideas and problems that were forwarded by operators. Companies that fail to implement a similar approach in their organization may well miss a fair amount of free improvement potential.

After a brief discussion of traditional suggestion systems, the next section of this article will discuss theories of *kaizen* and *performance management* that can be of value to the re-design of suggestion systems. Then, the design rules inferred from these theories will be presented. In order to test the value of these ideas we performed a longitudinal experiment. This was done by the re-design of the suggestion system for the business unit of a multinational company that collaborated in this research project. The experiment started on a limited scale in 1996 and on a BU-wide scale in 1998. After an analysis and discussion of our experiences with the system, the article will be concluded with some of the main lessons learnt.

2 Theoretical background

In order to find a fundament for the re-design of suggestion systems, we studied traditional suggestion systems, *kaizen* literature and *performance management* theory.

2.1 Traditional suggestion systems

The usual way for employees to contribute to improvements is to submit suggestions through a suggestion box. As mentioned before, such systems have a long history but a mediocre effectiveness. We need to realize that unconscious copying of elements of traditional systems may lead to unconscious copying of its mediocre effectiveness too. The first suggestion systems appeared in the United States during the 19th century. Starting from a paternalistic point of view, industrial leaders got the idea that blue-collar workers should be able to contribute to improvements too. The initial successes led nearly all large enterprises to develop their own suggestion systems [6]. Since the birth of suggestion systems, their structure has hardly changed. Usually, a strong emphasis lies on a direct financial advantage for the employee and the organization. The only contribution of the employee is to actually submit suggestions. A special committee evaluates and implements them, and decides on whether and how to reward the employee. The bigger the possible financial savings, the bigger the financial reward. However, again, if we copy the central elements of such institutionalized and bureaucratic suggestions systems [7], we will copy their effectiveness too, which, however, is usually below contemporary requirements.

2.2 Suggestion systems in the context of kaizen

Imai [8] indicates that suggestion systems are an integrated element of *kaizen*. There are a number differences and similarities between the way suggestion systems are incorporated in this Japanese approach to continuous improvement as compared to Western suggestion systems. First, the visibility of top management commitment is clearer in the case of *kaizen*. Unlike their Western colleagues, Japanese top managers show their interest by attending improvement meetings on workshop level. Furthermore, *kaizen* stresses the *number* of suggestions, rather than the financial or other savings achieved. This has to do with the fact that *kaizen* uses suggestion systems as a vehicle to enhance morale and continuous improvement awareness. A similarity of both approaches is that they require the employee only to submit suggestions. Other staff members are responsible for the selection, development and implementation of the suggested improvements, although it is not unusual to involve the employee(s) who first suggested them in the implementation. This is in contrast to improvement teams, which tend to have a wider range of improvement tasks for the employees. A difference is that Western systems use pretty complicated procedures with a long lead-time, whilst in a *kaizen* situation the first line supervisors review and implement suggestions. *Kaizen* is process-oriented and focuses on creating new working standards. Traditional suggestion systems are primarily result-oriented. Another difference is that *kaizen* has a stronger focus on improving the individuals' own working area, whereas traditional systems leave more space for suggestions on any aspect of the business, as long as it results in large savings. Also, *kaizen* focuses on improvements that are inexpensive to implement, whilst traditional

systems stress net savings. Finally, most *kaizen* systems have no reward system. If there are specific rewards for suggestions in a *kaizen* system, there is only a weak relation between the net savings and the size of the reward. For example, at Canon, the maximum reward is two hundred pounds [8]. In order to classify them, the suggestions are put into categories like Silver, Gold or Platinum. Each category renders a certain financial reward and a symbol (button or document). Not the reward itself, but the way it is delivered, by the CEO, or a photo in a news bulletin, is important. It must be stressed that suggestion systems are only one integrated element of a wider approach in most *kaizen* programs [9]. According to Imai this results in an average of 19 suggestions per employee per year in Japanese suggestion systems. Table 1 shows the major differences and similarities between traditional suggestion boxes and individual contributions in *kaizen*. The numbers in the right-hand column are used in Section 3, which describes the longitudinal field experiment we conducted.

Table 1 Traditional suggestion systems for individuals compared with the *kaizen* approach to individual suggestions

Traditional suggestion box	*Individual contributions in a kaizen environment*
Stand-alone system	(1) Individual CI integrated part of system
No visible top-management interest	(2) Highly visible top-management interest
Emphasis on financial savings	(3) Also emphasis on morale and *kaizen* awareness
Emphasis on financial savings	(4) Emphasis on number of suggestions
Main employee role: suggesting	(5) Main employee role: suggesting
Long complicated off-line procedure	(6) Quick evaluation and implementation by supervisor. Employees participate in the implementation
Main orientation: result	(7) Main orientation: process (new work standards)
Prime focus: any idea	(8) Prime focus: own working area
Net savings count, investment is acceptable	(9) Focus on inexpensive, easy to implement changes
Extreme rewards possible	(10) Weak relationship between level of reward and savings achieved. The way to deliver reward is important.

2.3 Performance management as a basis for suggestion systems

Performance management (PM) is a practical instrument that can be used to stimulate or decrease certain behaviours. In contrasts to *kaizen*, which is based on practice, PM is based on a range of behaviourist, clinical psychology theories. Although *performance management* is not directly linked to the practice of improving operations or to *kaizen*, Daniels [10,p.208] states:

> "The book *kaizen* is filled with examples of how the Japanese use this concept in their work. Although Imai does not mention positive reinforcement specifically, it is evident in many of his illustrations. Any one person seeking continuous improvement without an understanding of the practice … [of *performance management*, RWS & HL] … will ultimately be unsuccessful in attaining that goal."

The approaches have in common that they can serve as tools for the designer of suggestion systems.

The core of *performance management* theory is that behaviour is learned through experiencing its consequences. When behaviour has pleasing consequences, the frequency of that behaviour will increase. If behaviour is not rewarded, or if punishment is its sole consequence, it is less likely to be repeated. This so-called operant conditioning theory was first developed by Skinner [11]. Based on Skinner's and other theories, Daniels [10] developed the practical instrument called *performance management*.

Although the link between behaviour and consequences is fundamental to the approach, it is stressed too that certain conditions, so-called antecedents, need to occur in order to stimulate the behaviour. For example, people do not usually pick up a phone that doesn't ring (= antecedent). In an Antecedent – Behaviour – Consequence (ABC) analysis the links between the three are mapped. If we want to change behaviour, we need to change antecedents, consequences or both. However, consequences provide the key to performance. Although the bell is an essential antecedent to pick up the phone, it is even more crucial to expect someone to be on the line to talk to after the phone is picked up (= consequence). Antecedents will only have short-term effects when behaviour is without consequences. Antecedents work better when they are explicitly paired with consequences.

The consequences can be clustered in four groups. All four have a different effect on future behaviour.

Positive Reinforcement. (notation: R+)

A pleasant consequence follows the behaviour. This can be anything, ranging from a compliment, a financial reward, to a feeling of certainty. The effect is that the frequency of the behaviour will increase. Since management attention is an important reinforcer, managers often unconsciously reinforce. For example, when they give a lot of attention to people who complain, the behaviour of complaining will be reinforced.

Negative Reinforcement (R-)

The consequence of behaviour is that the person does *not* get something he dislikes. For instance, when someone opens the window, he will no longer suffer from the heat. The effect of R- is that the level of performance of the behaviour is just sufficient to avoid the negative consequences.

Punishment (P+)

The consequence of behaviour is that the person gets something he does not want. This can be anything, for example, being fined, a cynical remark from a colleague or physical torture. We are often unaware of the 'punishment-effect' of what we do. Imagine we want to reward someone (the intention is: R+). Then, the effect might actually be P+ if the reward (to have dinner with the boss and his wife) is felt as a punishment by the person concerned (who doesn't know how to behave in a 'real' restaurant). The effect P+ has on many people is just enough decrease of the behaviour to prevent punishment. The result will never be the maximization of certain behaviour. A difficulty with punishment is that people can get used to it when it gradually increases.

Extinction (P-)

In this case the behaviour is not reinforced whatsoever; it is ignored. An example is a vending machine that does not give a cup of coffee after inserting money. Although the behaviour may be repeated, people will gradually 'try' the behaviour less and less. When someone used to get reinforcement before, he might intensify the behaviour in the disbelief that the behaviour does not render any positive effects anymore (extinction burst). Gradually, however, the behaviour will extinct. After some time, the person might try again (resurgence). If still no reinforcement follows, extinction will result again.

The effect of consequences on behaviour is stronger when a consequence is Positive, Immediate and Certain (PIC).

Positive reinforcement (R+) keeps increasing behaviour. When 'A0' and 'A1' are alternative behaviours, positive reinforcement of the behaviour 'A1' can increase the effectiveness of negative consequences (both R- and P+) of behaviour 'A0'. This effect is optimal when a maximum of one negative consequence is given for every four positive consequences.

The quicker the reinforcement, the easier it is for the person concerned to link the behaviour to the consequence. It is most effective when consequences start before the behaviour has ended.

In a learning program, initial certainty of reinforcement is maximally effective. Later, various schedules are possible to reinforce. If initial certain R+ is followed by intermittent reinforcement, the behaviour will continue. However, a minimal level of R+ is always needed, otherwise extinction will result. This may even be an instrument to avoid the problem of satiation. Various intermittent schedules exist, which have a varying effectiveness. The Variable Ratio (VR) is most effective. In this schedule, the reinforcement comes as a surprise. The person does not know exactly when the reinforcement will be delivered. It can be compared to a slot machine in a casino.

A number of further rules reflect the degree to which behaviour is changed as a result of antecedents and consequences.

When positive reinforcement (R+) and negative consequences (P+) are combined in one message, the reaction will be: "what have I done wrong now?". So, if a manager combines punishment and positive reinforcement to 'soften' the shock of the punishment, the result will be that the receiver will perceive the reinforcement as an antecedent for the punishment that is bound to will follow. The effect will not take place when reinforcement and punishment take place at different occasions. However, the same mechanism works if reinforcement is combined with new goals. The new goals will have the character of a punishment for the receiver. Furthermore, the more specific a reinforcement is linked to a certain behaviour, the stronger its effects.

Another point is that people react differently to similar consequences. As a result, it is ideal when consequences are individual-specific. Also, the reinforcement is most effective if it is delivered in a personal way, as the delivery of the reinforcement itself will already be a reward.

If the consequences of behaviour take place in the light of an internal competition, the effects will be different. Internal competition will result in withholding information and reduced co-operation. Also, the many people who don't win the competition will be demotivated. A similar phenomenon will take place if there is a selection of an 'employee of the month'. The effect of a short contest, with small prizes that compete against standards or against previous performance can be positive, as long it takes place in an

atmosphere of fun. Tangible reinforcers should not be too big, because many people will tend to think that they won't win it. Furthermore, there is also a risk of satiation.

2.4 Design rules

We inferred the following design rules for suggestion systems from the *performance management* theory:

(a) A suggestion system should include *antecedents*. An antecedent is a condition that makes people aware of what to do, how to do it or anything that takes away obstacles to do it. Antecedents enable the contribution of employees, e.g., training, simple forms and reminders that the suggestion box welcomes ideas, aid in the completion of forms, time.

(b) A suggestion system should mainly use *positive reinforcement*.

(c) The reinforcement should *be frequent, individualized/personalized, varied and not only monetary*.

(d) A suggestion system should have a *short lead-time* and quick feedback, to result in *immediate* consequences.

(e) A suggestion system should be *certain* (predictable) in its effects. It must be sure that correct behaviour is reinforced. As a consequence, the system should be clear in its procedures. Use of quantitative data may help.

(f) A suggestion system should *avoid punishment* of idea generating behaviour. For example, the system should avoid the possibility that the rejection of improvement ideas is perceived as a punishment.

(g) An *intermittent* reinforcement system can used to avoid satiation. Especially Variable Ratio schedules should be considered.

(h) Reinforcement should not be combined with *new goal setting*.

(i) *Internal competitions* should be avoided, unless it is a short-term contest with small prizes with a high fun-factor.

(j) Tangible reinforcement shouldn't be too large to *avoid satiation* and to avoid focus on large improvements only.

Besides the rules (a) – (j), which are based on *performance management* theories, Table 1 is a summary of the design rules, numbered (1) – (10), which we inferred from *kaizen* theory [8]. The lists share a number of requirements. The consequent use of all these design rules will result in a system that differs radically from traditional suggestion systems, for example in its pace, its focus on small improvements and in the types of reinforcement used.

3 Experiment: use of the design rules in practice

3.1 Methodology

In order to test the design rules that are suggested above, we performed a longitudinal experiment. In this article, the first 26 months are reported. The central idea of the

experiment was the development of an effective improvement organization by application of the design rules in practice. The experiment had the character of action research, in the sense that modifications in the approach were made during the experiment. These modifications all stemmed from the fact that no translation of the theory to practice was readily available. We didn't expect nor actually notice a Hawthorne-effect to occur, as it was never announced in the company that the changes in the suggestion system were in fact a scientific experiment.

3.2 The company and its existing suggestion system

The organization that cooperated in this research project is a business unit of an aerospace company. In 1994 the company delivered an excellent quality and delivery accuracy. However prices, and thus cost, had to be reduced by at least 30% in total. One of the core elements of the strategy was Continuous Improvement (CI). The program started with the introduction of improvement teams. The CI program emphasized the integration of CI in the business strategy, policy deployment, change of culture and the development of communication and information channels. Most effort was put into the realization of improvement teams. Initially, five improvement teams were introduced to the concept of CI and trained in the use of some improvement tools. The number of teams grew gradually. After a difficult start, some of the improvement teams became successful and they came with many suggestions. Other teams were not successful. An explanation put forward at the time could be that the existing suggestion system rewarded individual suggestions with money, whilst there was no reward system for improvement teams. A closer look at the existing suggestion system suggested that the existing suggestion system wasn't the right way to achieve CI at the level of individuals. Typical characteristics of the existing system were:

- A specialized committee judged the suggestions.
- Difficult evaluation procedures resulted in an average lead-time of six months, with a maximum of three years.
- About 80% of the suggestions were rejected due to, amongst others, the poor quality of many suggestions, and the high costs involved in changing the existing situation.
- The system emphasized financial rewards, which could be as high as 8.000 Euro.
- In effect, it was estimated (due to lack of data on the exact number of ideas submitted) that on average less than 0.5 suggestions were submitted per employee per year.

As a consequence, the suggestion system did not contribute much to the CI strategy of the company.

3.3 The design of the new suggestion system and its results

On the basis of the theory, a new system was designed in 1995. By the time the design was ready, the company found itself in the midst of a crisis. This resulted in a move of the business unit to the site of a sister business unit, followed by the parent company going bankrupt, the sale of both business units to another holding company and finally the merger of the two sister business units. Because of all this, the test (hereafter called initial phase) of the new suggestion system had to be postponed, to the period between

November 1996 and April 1997, in the parts of the business that belonged to the original business unit. After evaluation the new system was slightly modified and implemented for the entire (newly merged) business unit. We will discuss the design that was used during the initial phase, the evaluation, the modification and the results of the current design. The business unit where the current design of the suggestion system is being used has a turnover of 70 million Euro with a total of 600 employees.

The rest of this subsection discusses how we translated the design rules into a practical system, which was consequently tested during the initial phase. We start with the *kaizen*-based rules, numbered (1) to (10), followed by *performance management*-based rules, numbered (a) to (j)

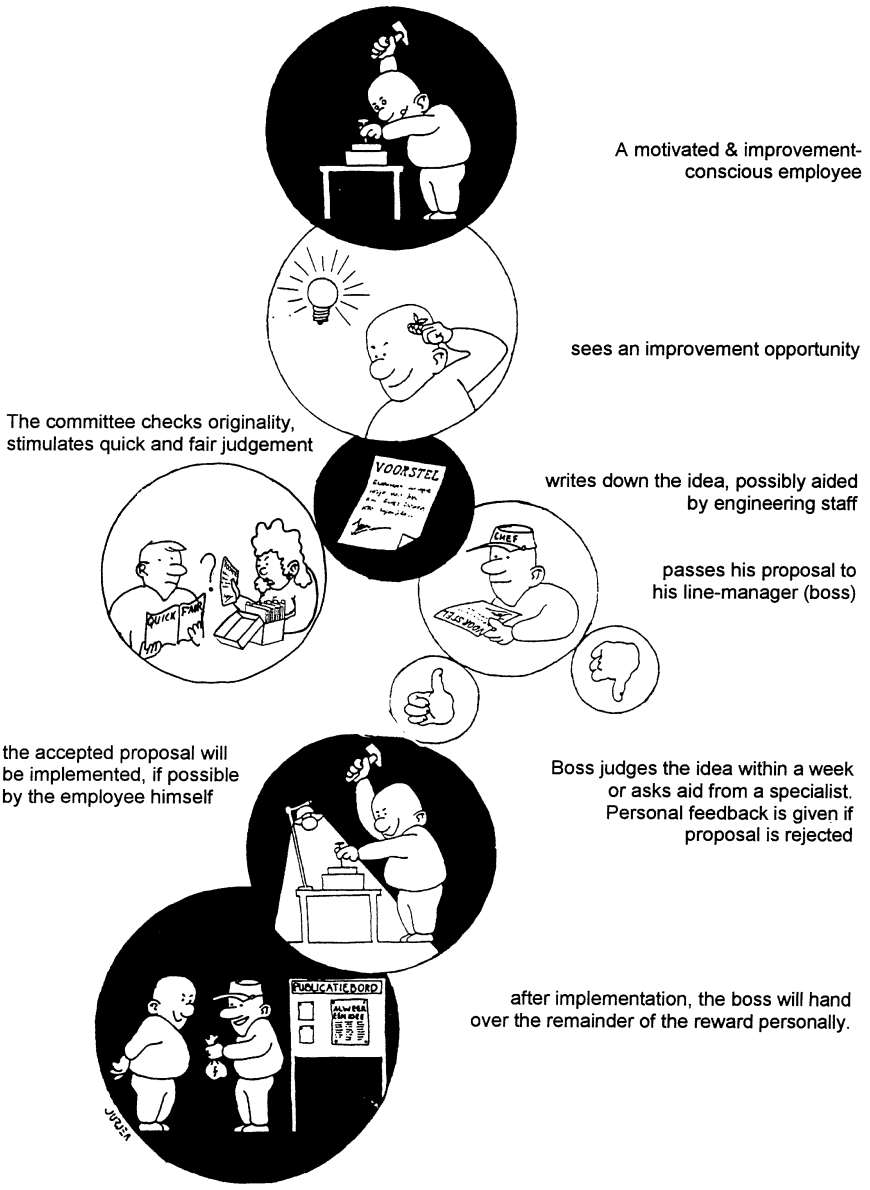
In order to keep a link to other ways of improvement (1) a similar reward schedule was developed for improvement teams. To emphasize top-management commitment and non-financial rewards (2) managers were involved in the actual hand-over of the reward. To stress the importance of all improvement behaviour (3) and to put emphasis on the number of suggestions (4), the reward schedule rendered a relatively high reward for 'small' improvements. Also, the schedule developed to determine the reward for improvement ideas – see Table 2 – puts a lot of emphasis on non-monetary effects of the suggestion. The main role of the employee to submit suggestions (5) was retained. However, employee involvement in the actual implementation of changes was increased. In order to achieve a quick procedure (6), bulky procedures were avoided; only a simple flow-diagram (Figure 1) and a schedule to determine the reward (Table 2) were created. Also, there would no longer be a central committee to evaluate suggestions. Instead, line managers would do this job. To create a focus on the process, rather than the results, of continuous improvement (7), the reward would only be actually handed over after implementation. We have chosen not to limit the scope of suggestions to the employees' and teams' own working area (8), as the experience with the previous system showed that ideas with a wider scope could be of great value too. However, in publicity campaigns it was made clear that suggestions should preferably concern the persons' own working area. For the same reason, we did not choose to focus on quick, easy to implement ideas only (9). The choice to give a relatively high reward for small improvements (10) has already been mentioned.

Table 2 Evaluation of improvement suggestions [12]

Evaluation criteria	*Score*			
	limited	*fair*	*considerable*	*extreme*
Creativity and originality	1(2)	7(8)	14(14)	20(20)
Degree of detail in the solution and the role of the employee in this	1(1)	4(4)	7(7)	10(10)
Suitability for other departments or other (future) products	1(2)	4(8)	7(14)	10(20)
Net economical benefit (5 years)	1(5)	10(15)	20(25)	40(40)
Short pay-back period [13]	1	4	7	10
Indirect consequences (quality, safety, environmental)	1(1)	4(4)	7(7)	10(10)
Reward (Euro): points * 11 =				

There is a certain overlap between the design rules that derive from *performance management* theory and the *kaizen*-based design rules. For example, the immediacy and reinforcement stressed by *performance management* theory is fulfilled by the quick procedure that is based on *kaizen* practices.

Figure 1 A flow-diagram developed as part of the final version of the suggestion system (original in Dutch)



So, on the basis of *performance management*, we tried to identify antecedents (a) to improvement behaviour. As it is a problem for shop-floor employees to put improvement ideas in writing (see also [2,4]), we developed simple forms and created the possibility to get assistance from engineering staff and line management to complete them. In order to give mainly positive reinforcement (b) we designed the system in such way that it reinforces all 'suggesting behaviour'. Furthermore, we tried to avoid 'punishment' that would result if a response to rejected suggestions would have a negative nature. Instead, one of the routines we built into the system was that an explanation would be given as to why a suggestion was rejected (used facts), while still a small reward would be given. In order to make the reinforcement frequent, individualized, personalized, varied and not only monetary (c) we created a clear role for the line manager. He/she will manage the evaluation of the idea and also give the reward. The line manager is able to give any reward other than monetary. The way the suggestion is treated gets a personal 'flavour' as the line manager will normally check certain details about the idea with the person who first suggested it. The line manager is trained to discuss things in a positive way. To make sure that all desired improvement behaviours would be rewarded (= reinforced) (e), we kept the schedule to determine the size of the reward as simple as possible, so that each employee could determine his/her reward in advance (see Table 2). Furthermore, employees are being motivated in many ways to make improvements. The most important motivator is fun, to implement one's own suggestion, and to get appreciation from both peers and management. So the system has to work well to make it fun. Other important motivators are rewards. First, every suggestion will be rewarded. The employee will get a small reward after the evaluation (f), irrespective whether the suggestion will be implemented or not. Initially, design rule (g) was not used, in order to avoid complexity. Competition was avoided in line with (i). The maximum reward (j) was already discussed.

The system was evaluated after the test period. Table 3 shows the results of this initial phase and relates them to the performance of the existing systems and the final design. The conclusion was that the number of ideas per employee per year had doubled. Also, the percentage of useful ideas had grown considerably. The net effect was that the number of suggestions that actually led to a change in the organization showed an eight-fold increase. This was partly due to the fact that employees started to concentrate on improving their own working environment. A very positive point of the tested suggestion system was its short lead-time of five weeks only. It must be noted that the suggestion box got extra attention by the use of a publicity campaign. This in itself proved to be a form of antecedent. In the future extra publicity for the suggestion system will be continued.

Table 3 The results of the suggestion systems in the various phases

	existing schedule (BU1)	*existing schedule (BU2)*	*initial test-phase (only BU 1)*	*current design (BU 1 & 2)*
period	until Nov '96	until Dec '97	Nov '96- May '97	Mar '98-Dec '98
# ideas per employee per year	0.25 (average) 0.5 (max)	0.17	0.60	0.50
% useful suggestions	20%	45%	65%	50%
lead-time (weeks)	26	25	5	6

Before the start of the initial (test) phase, a number of difficulties were anticipated. The traditional suggestion box and especially the complicated process improvement ideas had to go through, made people sceptical about the system. We thought it would be difficult to change this culture, but this did not appear to be a problem in practice. *A striking result of the test was that it was those people who participated in improvement teams, who were the most active users of the suggestion system*. This proves that the system for individual contributions to improve does not *per se* harm the effectiveness of improvement teams or *vice versa*! At this stage, the anticipated introduction of the reward-schedule for teams had not yet been implemented.

After some time, the activity of the CI-teams eroded, due to a lack of activity of their coaches. Still is seems as if the CI teamwork has permanently changed the attitude of the former team-members, as many of them are amongst the most enthusiastic contributors to the individual CI suggestion system.

However, a number of other difficulties showed up in practice. These difficulties had to do with the immediacy and certainty of the consequences of behaviour, with the antecedents of behaviour and with the problem focus in the program. As a consequence, a number of changes were made in the design. To increase the immediacy, a committee was re-installed. One of their roles was to stimulate persons who have to do the actual evaluation and implementation to realize a short lead-time. Also, the immediacy was improved through a provisional reward that is given as soon as the idea is accepted, with the remainder following after implementation. As regards the certainty, a serious problem was that the employees complained that the lack of procedures made the way the system works less certain. It is interesting to notice this, as we had simplified the procedures as an antecedent! To make the way of working more certain, a procedure was put on paper. The official procedure serves as a 'back-up'. Another point that concerns certainty was the determination of the reward. Although the managers involved did not find it difficult to make consistent evaluations of suggestions and to decide about the reward, employees felt more certain on this point after we reinstalled a committee that checks that no mistakes are made in determining the reward.

Other problems were related to antecedents. First, we discovered that special attention for the CI suggestion system helps to continue the stream of ideas. So, every few months, a publicity campaign is realized. We also use these occasions to include a further design rule that was derived from the *performance management* literature, Variable Reinforcement (i), which was implemented as an internal lottery, with lottery vouchers for nice but relatively small prices. Second, we presumed that the system would probably ask too much time and energy from line managers. The new suggestion system requires the superior to evaluate suggestions submitted, to determine the reward, and to support the employee(s) with the implementation of the suggestion. On the one hand, it appeared that line managers enjoy doing all this. On the other, it was indeed a problem during publicity campaigns. Consequently, future publicity campaigns will be somewhat restricted to avoid this problem. The alternative would be to increase the capacity of line managers to work on suggestions. We have recently tried this during a publicity campaign. During this period an industrial engineer had the full-time job of assessing suggestions quickly. This worked out quite well. Third, a simple computer system was installed to support the registration and monitoring of suggestions for the reinstalled committee. In order to be able evaluate an idea, it is necessary to check if the idea has been suggested before. The computer-system enables this.

Finally, a number of problems were related to the focus of the suggestions. First, the reward for relatively small suggestions was far too high. Employees felt uncomfortable about it and managers even more. Table 2 reflects both the original figures and the modified version. Second, the reward for rejected ideas has been abandoned, as people felt uncomfortable being rewarded for ideas that couldn't be implemented. They felt a lack of focus on problems that really matter. Instead it was stressed again that everyone gets personal feedback on why the idea is of limited value. We concluded that such personal feedback on rejected ideas served as a reward already. Finally, although the final reward system still stresses the importance of small improvements, the possibility of a very large reward for an idea with an extremely big (financial) impact is re-introduced. Employees felt that it would be unfair if the company did not reward such a big contribution to the competitiveness of the organization. The reward is 20% of one-year net-savings. The newly installed committee assesses this and does so quickly as this type of idea shows up only very occasionally (three per year).

In practice it showed to be very time-consuming to reward in a personalized way. Still, it was decided not to change this, as personal explanation serves as an important positive reinforcement. As a consequence, the capacity of line managers to assess ideas proves to be the bottleneck of the improvement organization, not the employees' creativity to come up with new suggestions.

The net result of the initial phase was that the system was fine-tuned, rather than re-designed. The nature of the design was retained. Also, the effectiveness of the final design was similar to that of the initial design (Table 3).

4 Conclusion

In this longitudinal experiment design rules were derived from *kaizen* and *performance management* theories. These design rules served as a basis to create a suggestion system. Amongst other things, the design rules include *kaizen*-based notions, like focus on the number of suggestions rather than the impact of individual suggestions, weak relationship between the size of rewards and the savings achieved through them, and quick judgement of the idea by the supervisor. Also, *performance management* based rules are included that pay attention to antecedents that make people aware of the importance of improvement ideas, help people submit suggestions, and take away obstacles to actually do so. Positive reinforcements are pleasant consequences of suggesting behaviour. Immediacy of positive reinforcement is important, since the quicker people are reinforced, the stronger the increase of the right behaviour. Finally, the more certain the reinforcement, the stronger the increase of the right behaviour.

The development and experimental implementation of the system demonstrated that the use of general design rules based on *kaizen* and *performance management* theories is a versatile basis for coping with specific problems and making small modifications in the design of the system, without losing the link to proven theory. The effectiveness of the system is very satisfactory.

Kaizen theory and *performance management* theories have entirely different backgrounds. The *kaizen* theory is built on practical experience in numerous companies. The *performance management* theory is based on clinical research. Still, the design rules that are derived from the two theories have quite a few characteristics in common. For example, both stress that the pace of action is important. Also, both stress that rewards

shouldn't be large. This suggests that *kaizen* and *performance management* fit together nicely, in spite of their different backgrounds. *Kaizen* may benefit from the scientific basis of *performance management*. At the same time, *kaizen* adds practicality to the *performance management* approach. A number of elements of *performance management* fit gaps in *kaizen* theory, e.g. reinforcement schedules, preventing dysfunctional effects of internal competition, and creating the right ratio of punishment and positive reinforcement.

In the present article, a total of 20 design rules were applied. The adjustment of the design in the course of the years has taught us that an organizational body (i.e., a person or committee) is needed to guide and guard the application of these rules. Such person is an antecedent to suggesting behaviour of others in itself. In order to keep a suggestion system up-and-running it is necessary to permanently devote sufficient time capacity to the system. Capacity is needed for publicity campaigns and for assessing the ideas on middle-management level. Also, some organizational body is needed that helps the organization to work Positive-Immediate-Certain.

References and Notes

1 Schroeder, D.M. and Robinson A.G. (1991) 'America's most successful export to Japan: continuous improvement programs', *Sloan Management Journal*, Spring, pp.67–81.

2 De Lange-Ros, D.J. (1999)'Continuous improvement in teams. The (mis)fit between improvement and operational activities of improvement teams', *PhD thesis*, University of Twente, Enschede.

3 Lindberg, P. and Berger, A. (1997) 'Continuous improvement: design, organization and management', *Int. J. Technology Management*, Vol. 14, No. 1 pp.86–101.

4 De Lange-Ros, D.J. and Boer, H. (1998) 'Continuous improvement in teams: a review of literature and an examination of the problems in practice', *Proceedings of the 2nd international EuroCINet Conference on Continuous Improvement: from Idea to Reality*, Enschede, The Netherlands.

5 Schuring, R.W. (1996) 'Operational autonomy explains the value of group work in both lean and reflective production', *Int. J. Operations and Production Management*, Vol. 16, No. 2, pp.171–182.

6 Liesker, F. (1990) 'Ideeënbus sluit aan bij kwaliteitsdenken', *De Ingenieurskrant*, November.

7 Rhijnsburger, L. (1986) 'Ideeënbus weer in trek door kwaliteitskringen', *Economisch Dagblad*, 11 July.

8 Imai, M. (1986) *Kaizen. The Key to Japan's Competitive Success*, Random House, New York,

9 Robinson, A. (Ed.) (1991) *Continuous Improvement in Operations. A Systematic Approach to Waste Reduction*, Productivity Press, Cambridge, Mass.

10 Daniels, A.C. (1989) *Performance Management. Improving Quality Productivity Through Positive Reinforcement*, Performance Management Publications, Tucker, Georgia.

11 Skinner, B.F. (1971*) Beyond Freedom and Dignity*, Bantam Books, New York.

12 This table is used to determine the size of rewards. It enables employees to determine their reward before their suggestion is actually evaluated. The table puts less emphasis on economic impact than traditional schedules do. In the initial stage of the experiment this was even more extreme (values between brackets). However, it appeared that small improvements were rewarded too much, while really big savings were not rewarded accordingly. In this light the current values were chosen. At the time of writing of this article, a bigger reward, of one-fifth of annual savings, was re-introduced for ideas with an exceptional impact. This type of reward is seldom used, perhaps two or three times per year.

13 This criterion was added to the final version of the suggestion system, after it had first been tested in practice.