

# ANALYSIS OF THE POSSIBILITY OF USING THE KAMISHIBAI AUDIT IN THE AREA OF QUALITY INSPECTION PROCESS IMPLEMENTATION

Krzysztof KNOP<sup>1</sup>, Robert ULEWICZ<sup>2\*</sup>

<sup>1</sup> Częstochowa University of Technology, Częstochowa; krzysztof.knop@wz.pcz.pl

<sup>2</sup> Częstochowa University of Technology, Częstochowa; robert.ulewicz@wz.pcz.pl

\* Contact: krzysztof.knop@wz.pcz.pl; tel.: +48-34-3250-367

**Abstract.** The article analyses the possibilities of using the kamishibai audit in the area of quality inspection process implementation. The kamishibai audit is a tool of lean and visual management concept used, among others, in the Toyota automotive company in order to verify their compliance with standards. This audit can, in effect, contribute to the improvement of processes. In the article, the kamishibai audit was characterised, the characteristics of the audit that determine its usefulness in the area of quality inspection processes were identified, and an example procedure for the implementation of the kamishibai audit in the examined area was presented. The article also presents the characteristics of the successful implementation of kamishibai audits and ways of enhancing their effectiveness. It has been proven that kamishibai audits can be successfully used to evaluate standards in the area of quality inspection processes.

**Keywords:** audit, quality inspection, standards, improvement.

## 1. Introduction

Quality inspection consists in the evaluation of specific properties of a product and/or a process against client-defined specifications or internal regulations of the company (Borkowski, and Knop, 2016, p. 25). Quality inspection is also defined as a regulatory process which aims to correct the differences between the defined standard and the actual results of the process (Lisowski, 2004). Apart from 'evaluating', quality inspection itself also requires evaluation. Quality inspection is first and foremost expected to be effective (Kujawinska et al., 2018) and efficient (Hamrol, 2015, p. 309). There are many methods for assessing the effectiveness and the efficiency of inspection processes, with measurement system analysis procedures – MSA or ratio analysis – deemed particularly recommended (Knop, and Borkowski, 2011; Starzyńska, 2018). Apart from effectiveness and efficiency, the quality of quality inspection processes in terms of their compliance with requirements (procedures,

standards, regulations) is also (primarily) important. Requirements for quality control processes should be defined and documented in order to avoid any grounds for questioning their existence. This is due to the fact that 'if there is no requirement, there is no non-conformity' – a failure to meet (documented) requirements is the basis for determining a non-conformity. Requirements concerning the way in which a quality inspection process should be conducted can be found in the inspection plan or in inspection instructions. Standards related to quality inspection can assume different shapes and forms (document, table, physical reference standard, light signals). Their presence is indispensable for evaluating the quality of quality inspection processes. Standards also constitute a basis for the improvement of quality inspection processes. Verification of compliance with quality inspection standards may be an element of daily and defined activities of the quality inspection staff or take place as part of periodic audits of quality (inspection) systems. Usually, these audits assume a structured form, they are performed by specific individuals with confirmed qualifications (training and certificates), and they are announced beforehand. Such audits have certain flaws (e.g. one can prepare for the audit in advance, auditors may not be impartial). Other forms of audit exist to replace 'traditional' audits; fast and simple, requiring no specialist, often hours-long training, involving verification of a selected aspect, an audit process/area 'point' only, and auditor-friendly due to the involvement of visual forms, where practically any member of the organisation can act as the auditor. These audits are called kamishibai audits. The aim of this article is to analyse the possibility of using this type of the audit in the field of quality inspection process implementation. Such audits may be a tool for evaluating the quality of implemented quality inspection processes and verifying compliance with standards in the area of the quality inspection process implemented.

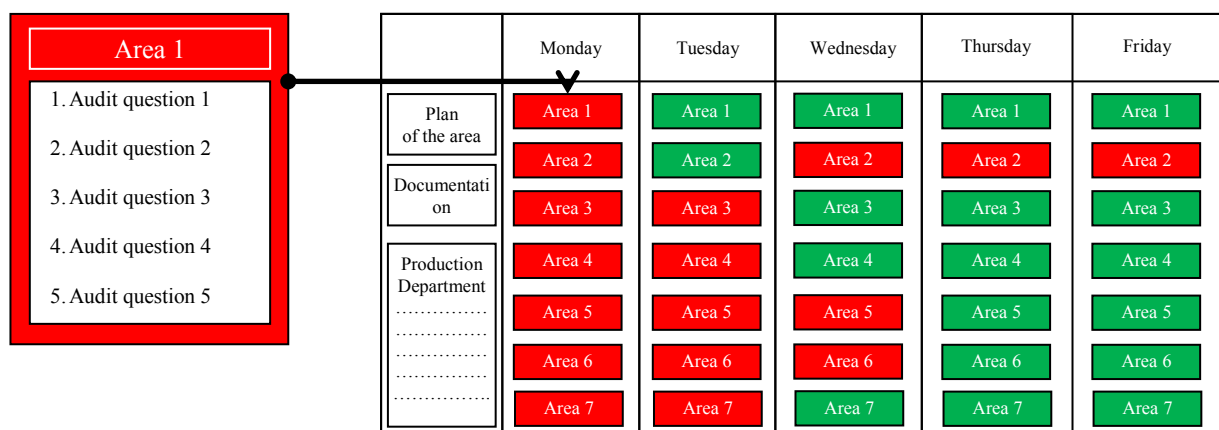
## 2. Method

The subject of this analysis is the kamishibai audit. Kamishibai is a Japanese term for paper theatre (Paatela-Nieminen, 2008, p. 91), picture theatre, or illustration theatre (Słownik japońsko-polski, 1997, p. 300). It is a traditional Japanese art of telling stories through pictures (Nash, 2009). It all started in the 12th century Japan, where kamishibai was used as a simple and effective way of communicating with illiterate people. Nowadays, the kamishibai theatre is used in schools and kindergartens, where it serves as a teaching aid (De las Casas, 2006; McGowan, 2015).

The term kamishibai has been incorporated into the lean manufacturing concept, and it exists within it as an audit tool. The kamishibai audit is one of the tools of this concept (Rewers et al., p. 135), used in the Toyota production system and others (Kaizen Institute, 2013). Within the lean environment, the kamishibai audit is a layered audit system (Kuc,

2009; Niederstadt, 2014) covering a specific area and verifying compliance with standards within it through direct observation. It is a standardised method of 'inspecting' a specific area/zone, combined with detailed knowledge of the standards applicable to a given field, aimed at verifying whether a standard is complied with. The purpose of the kamishibai audit is ensuring 100% compliance with standards in a given audited area (Skalecki, 2017) through verifying whether work is performed in the best possible, reliable and productive manner, subject to the quality required (Firlik, 2017). In today's turbulent environment, numerous companies aim to increase productivity while decreasing costs (Nowicka-Skowron and Ulewicz, 2016, p. 149), while the kamishibai audit may be a lean tool enabling accomplishment of those goals. The kamishibai audit enables auditors to obtain new knowledge of the process/area audited; it enables its improvement through efficient implementation of 'gemba walk' and 'gemba kaizen' (Bremer, 2016; Imai, 2006). Popular areas of kamishibai auditors' interest include OHS and environment protection management, 5S, TPM, lean management related criteria, or ISO. The kamishibai audit may be implemented at production plants, laboratories, universities, financial institutions, healthcare facilities, etc. (Poots, 2016).

The kamishibai board and cards, which are visual management (VM) tools (Knop, 2016, p. 237-251; Ortiz Ch., and Murry, 2010) and visual control (VC) tools (Borkowski, and Knop, 2013, p. 25-28), are an integral element of the kamishibai audit. The kamishibai board is referred to as the green and red board because of the colours used. The colours indicate the result of the audit. They correspond to the colours of kamishibai cards. Kamishibai cards placed on the kamishibai board visually indicate which area, and to what extent, was positively assessed, and which one was not (Fig. 1). The kamishibai card contains a set of the same audit questions, in green on the one side, and in red on the other side. Green outwards, the card indicates a positive result of the audit; on the other hand, red indicates a negative result. A negative result means that at least one of the audit questions was answered negatively (Kamishibai – audytuj standardy w prostszy sposób, 2017).



**Figure 1.** Dependency between the kamishibai board and the kamishibai card. Source: author's own elaboration based on (Kamishibai – audytuj standardy w prostszy sposób, 2017).

Both the cards and the board can come in various forms, design and execution. The number of questions on kamishibai cards may also differ, or they may feature no questions at all (in which case the colour of the card indicates whether the audit has had a positive or a negative result) (Johnston, 2012). Kamishibai audits can be carried out every day, month, or even hour, depending on the needs of the audit team (Fines, 2017).

### **3. Results**

#### **3.1. Kamishibai system implementation in quality inspection processes**

Kamishibai audits may cover virtually any process and area of activity in a company (Miller, 2009). Quality inspection processes may be covered by the kamishibai audit as well. Attempts have been made to implement the kamishibai audit to monitor quality inspection processes. It was assumed that kamishibai audits would be implemented in four steps, with step zero being a decision on the implementation of the audits and appointment of a working group:

##### **0. Decision on implementation and appointment of a working group**

Making a decision on implementation is step zero of the kamishibai audit implementation process. The decision is made by the management, based on the produced evidence of tangible benefits of having such a system in place. One of the anticipated benefits of such audits is the reduction of the number of errors regarding compliance evaluation in the product quality inspection process (Knop et. al., 2018, p. 857-867). The implementation decision may result from the benchmarking carried out, be imposed by the company owners, or arise from the company needs in that respect. The implementation working group should comprise owners of individual processes/areas to be covered by the future kamishibai audit, and it should have an appointed project manager.

##### **1. Board design**

Designing of the kamishibai board is stage one of the kamishibai audit implementation process. The board may be designed independently, generally available designs may be used (the so-called off-the-shelf solutions – purchase of a finished solution), or a board already used in another company may be used (benchmarking), the solution may be transferred then, or an original version of the board may be developed. Sieradz, Poland based company Scanfil, an electronics manufacturer, decided to develop an original solution based on the board used by a foreign division of the company (Pik et al., 2007). The board and its structure have been shown in Fig. 2.



**Figure 2.** Kamishibai board design at Scanfil, Sieradz, Poland. Source: Pik et al., 2017.

An example off-the-shelf board has been shown in Fig. 3.

The advantage of the original solution is the ability to adapt the structure of the board (its size, shape, elements and their arrangement) to one's own requirements. In the case of an off-the-shelf board, it is not possible; a finished solution is based on.

## 2. Draft questions for quality inspection 'area(s)'

### 2.1. Development of a question database

First, prior to developing a list of questions, one needs to define and select the quality inspection areas to be covered by the kamishibai audit. A quality inspection area audit may cover any site in the production building or outside it, where the quality inspection process is carried out, namely (options):

- a work station,
- an inspection station at a work station,
- a general inspection station,
- a special inspection station,
- a final inspection station,
- a specialised laboratory,
- a test run station (Knop, 2015).

Depending on the quality inspection area to be audited, a relevant list of questions needs to be developed, and the questions need to be transposed into kamishibai cards accordingly. Development of the list of questions should be based on the existing standards in the quality inspection area audited, namely documents or other 'carriers' of information, i.e. e.g.

- inspection plans,
- inspection instructions,
- control and measurement equipment manuals,
- operating instructions,

- OHS instructions,
- standard operating documents (SOP, WES, OPL, others)

presenting the best practices in the quality inspection area audited.

Kamishibai board												
Day Shift	rea 1	Area 2	Area 3	Area 4	Area 5	Area 6	Problem	Actions	Who	When	Status	
Monday / Tuesday / Wednesday / Thursday / Friday / Saturday / Sunday	I											
	II											
	III											
	I											
	II											
	III											
	I											
	II											
	III											
	I											
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	III											

**Figure 3.** Dry wipe magnetic kamishibai board – an off-the-shelf solution. Source: [www.wally.com.pl](http://www.wally.com.pl).

The standard should be 'documented' and communicated to the employee beforehand so there are no grounds for contesting it (its existence and applicability) during audits. An example standard regarding callipers technical condition has been developed; it has been shown in Fig. 4. It is a standard developed in a visual form, in the form of a 'problem' OPL (Rosak-Szyrocka et al., 2017). It may be used to verify whether the callipers technical condition is correct. In this form, a standard may constitute a tool used during kamishibai audits. It is developed in a visual form, which ensures its communicativeness and friendliness to employees – potential auditors.



9. Have suspicious parts been classified as non-compliant?
10. Does the employee use the required PPE during inspection?

Audit questions may be universal or special. Universal questions enable verification of the compliance with a specific standard within different quality inspection areas (inspection stations), while special questions are dedicated to a specific quality inspection area only.

## 2.2. Question distribution to individual cards

Distribution of questions to individual cards is a very important task of the working group responsible for the implementation of the kamishibai system. Given the number of questions on a single card being one of the criteria, distribution may be carried in two ways:

1. 1 card = 1 question.
2. 1 card = several questions.

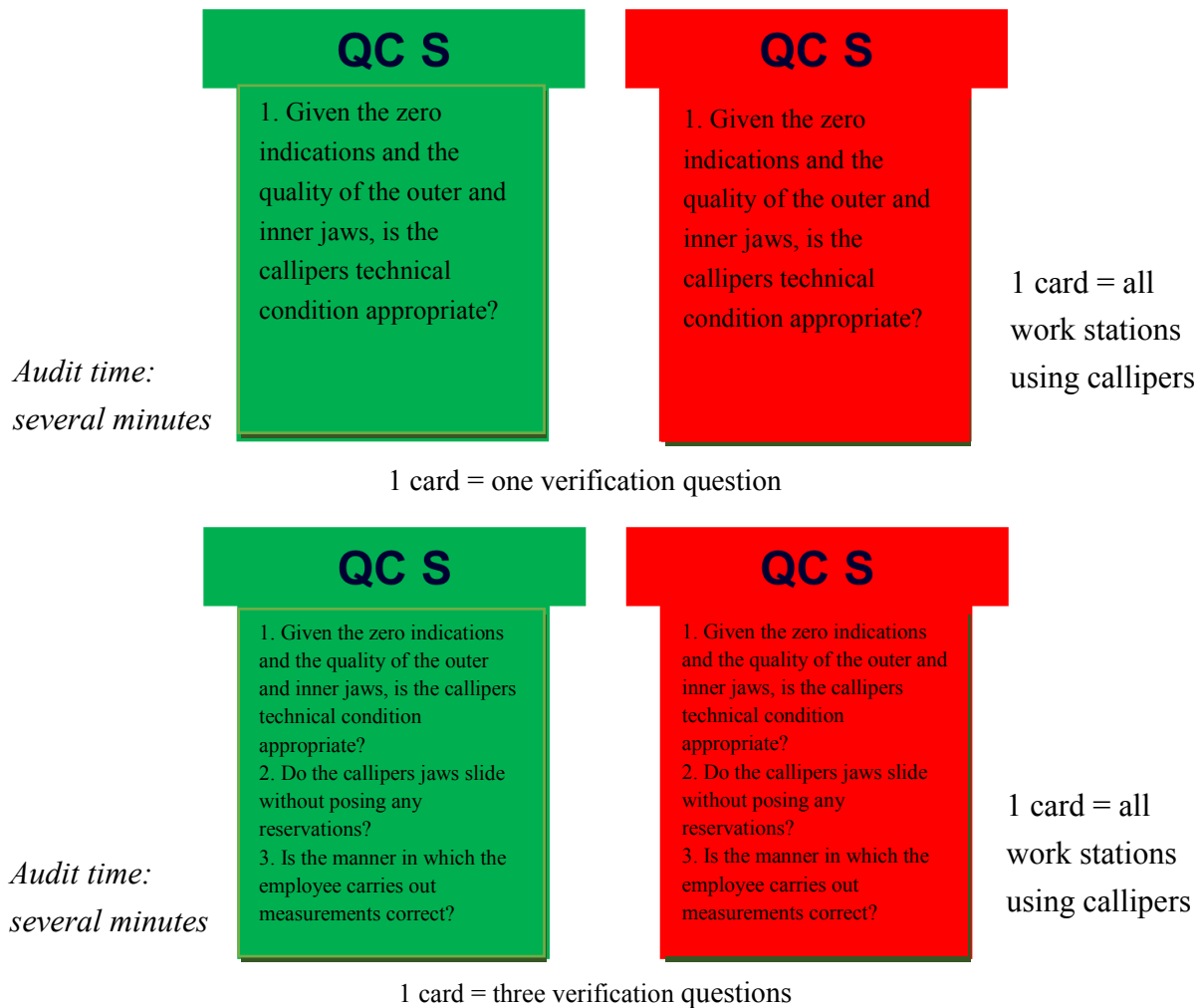
Given the thematic range, audit questions may be distributed according to a specific criterion, e.g. 4M/5M, or an original distribution criterion may be developed, e.g. 5S, OHS, Process, HR, Quality, etc. (in analogy to the procedure used in developing the affinity diagram –a new quality assurance tool (Hamrol, 2016, p. 290).

When distributing questions to individual cards, one should remember the following principles:

- a single kamishibai audit in a specific audit area should be as short as possible,
- there should be several audits per week,
- card 1 should feature an adequate number of questions to verify the standards in a given area of quality inspection,
- a single audit should not excessively distract the employee of the audited area from their duties.

Fig. 5 shows examples of developed kamishibai cards the purpose of which is to verify compliance with the standard regarding the callipers proper technical condition. Card 1 features one audit question; card 2 features several such questions. The number of questions we put on card 1 will affect duration of the audit itself. The cards shown below are universal, which means that they may well be used at those inspection stations which use the measurement equipment (callipers) in question.





**Figure 5.** A kamishibai card verifying the standard regarding the callipers technical condition, developed according to the following pattern: a) 1 card = 1 audit question; b) 1 card = several audit questions. Source: author's own study.

Kamishibai cards may also be special cards, i.e. they may be developed with respect to a specific inspection station; – in this case, audit questions will verify standards applicable to that station only. One will also need a 'reference point', i.e. a standard to be verified; preferably, it should be presented in a visual form. It has been assumed that at the inspection station X covered by the audit, it is a standard operating procedure (SOP) (Fig. 6).

nr	Czynność	Uwagi	Lay-out gniazda
!	Zapoznaj się z instrukcją stanowiskową kontroli/naprawy detalu.		
▲	1 Pobierz część z pojemnika po lewej	DETALE ZATRZYMANE N.OK DO 100%	
▼	2 Sprawdź część	Instrukcja 100% kontroli	
▲	3 Odłóż część zgodne do pojemnika po prawej oznaczonego etykietą Sprawdzone 100% (zgodnie z instrukcją)	Pojemnik z częściami OK. oznakować etykietą Sprawdzone 100%	
▲	4 Odłóż części niezgodne do pojemnika oznaczonego etykietą ZATRZYMANE DO.	Pojemnik z częściami N.OK. oznakować etykietą ZATRZYMANE.	
!	Wypełnij Arkusz kontroli/naprawy wyrobu		
Wymagane środki ochrony osobistej:			
CZAS JEDN. OPERACJI:			[sek]
Czynności okresowe		częst Jak?	
▼	KONTROLA CZĘŚCI	100% ocena części zgodnie z instrukcją stanowiskową 100% kontroli części.	
			Rodzaj kontroli: M - manualna V - wizualna A - automatyczna P - audit wyrobu
Arkusz			
<b>Plan reagowania</b>			
Symptom		Reakcja	
Nie zgodna część		Odłożyć detal do pojemnika z częściami N.OK, powiadomić lidera/inspektora KJ	
Urządzenie nie działa		Sprawdzić ponownie pojemnik z wyrobem gotowym, prawdopodobnie część przelożona bez operacji kontroli.	

**Legend (top to bottom, left to right):**

No. / Action / Comments / Socket layout

Read the detail inspection / repair work station instructions.

Collect parts from the container on the left. / Details retained. / Not OK up to 100%.

Check the part. / 100% inspection instructions.

Put compliant parts in the container on the right, labelled 100% inspected (according to the instructions). /

Container with OK parts to be labelled 100% inspected.

Put non-compliant parts on the contained labelled RETAINED. / Container with NOT OK parts to be labelled RETAINED.

Fill in the product inspection / repair form.

Legend

activity

material

storage space

critical actions

Single operation time / seconds

Periodic actions / frequency / How?

Part inspection / 100% / part evaluation according to 100% inspection instructions.

Inspection type

manual

visual

automatic

product audit

Form

Response plan

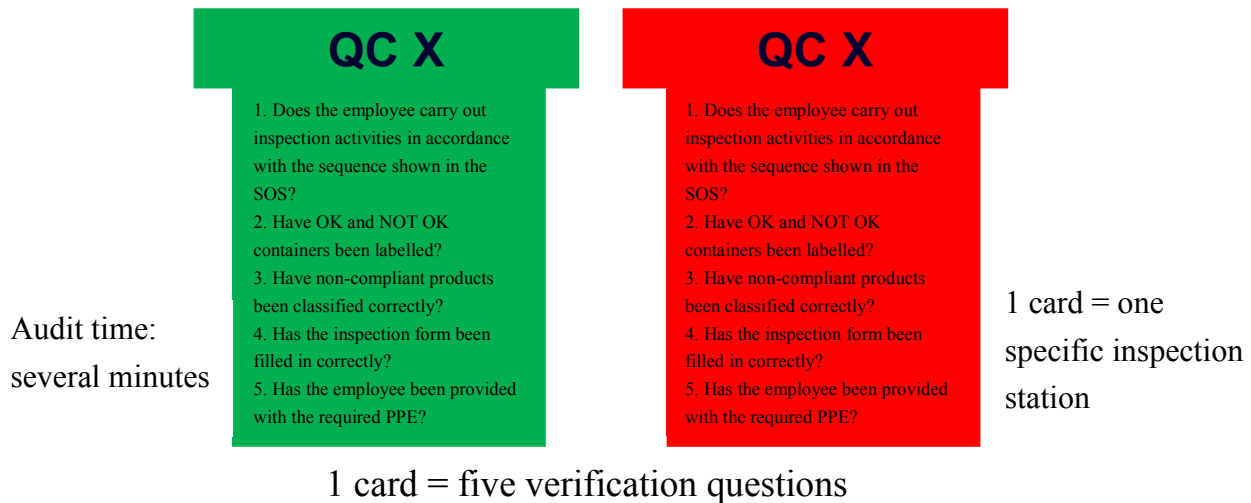
Symptom / Response

Non-compliant part / Put detail in container with NOT OK parts. Notify quality inspection leader / manager.

Device not working. / Check container with finished product again. Probably part relocated without inspection.

**Figure 6.** Standard operating procedure (SOP) at inspection station X as a standard. Source: author's own study.

Based on the guidelines presented in the standard (SOP), an example kamishibai card to verify compliance with the standard has been developed (Fig. 7). An audit of the type takes a dozen or so minutes.

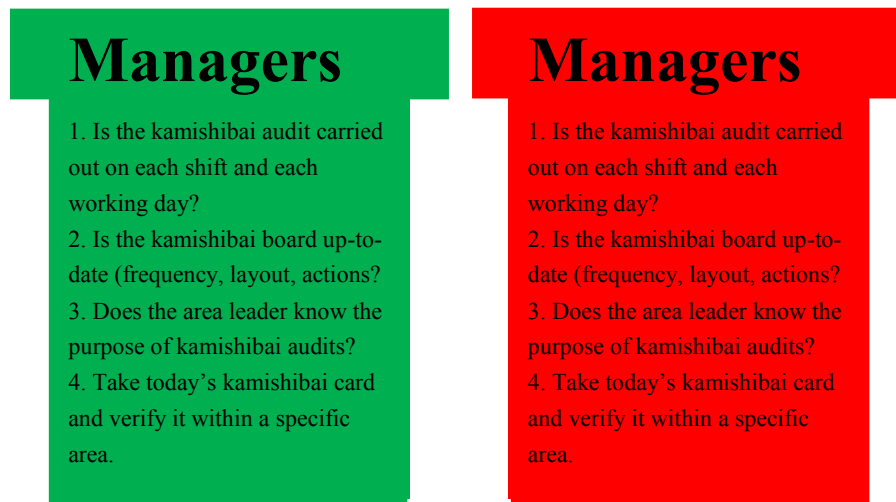


**Figure 7.** A kamishibai card verifying compliance with the standard at inspection station X, developed according to the following pattern: 1 card = several audit questions. Source: author's own study.

All the example kamishibai cards shown regard a situation in which compliance with the standard is verified with one document. It is a recommended kamishibai card design. One may also develop kamishibai cards the questions of which will relate to several standard operating documents; in this case, the audit will obviously be more time- and labour-intensive.

### 3. Development of questions for manager cards

In the kamishibai system, any employee may be an auditor (from a line employee to a mid- or high-level manager). Every employee – auditor should be acquainted with the kamishibai audit implementation procedure, and they should be trained in that respect. Apart from being able to carry out audits, managers also play a different role; it should be their objective to ensure that their procedure is observed. To that end, manager-dedicated cards need to be developed. Managers may verify whether audits are carried out, if board entries are up-to-date, or whether employees – leaders know the purpose of the audits in their areas. An example manager-dedicated kamishibai card has been shown in Fig. 8.



**Figure 8.** A kamishibai card verifying compliance with the standard at inspection station X, developed according to the following pattern: 1 card = several audit questions. Source: author's own study based on (Pik et al., 2017).

#### 4. Audit implementation

Audit implementation covers evaluation of standards in quality inspection areas/processes. Such audits should be planned beforehand, i.e. there should be an audit schedule, and persons should be appointed to carry them out. Who and when is to carry out an audit – this fact should not be known to the employees of the audited areas before (so that they cannot prepare themselves for the audit). Audits in specific areas may be carried out periodically (for example, monthly, weekly, daily), or they may be carried out at irregular intervals. The frequency of audits in a specific area may depend on the number of 'non-conformities' identified during audits: the more negative answers to audit questions (and, consequently, more red cards on the board), the more frequently audits may be carried out in that area. On the other hand, the fewer non-conformities identified, the less frequently audits may be carried out. Audits should not be discontinued even after several positive results due to the changing nature of the conditions prevailing during their implementation (different shifts, different employees, different working conditions, environment). Factors supporting more frequent kamishibai audits in a specific area may include:

- a new employee at a work station,
- a large number of non-conformities identified during previous audits,
- no static stability of the process and/or its low quality capability,
- low effectiveness of inspection processes identified in other examinations (e.g. through MSA procedures – the value of Cohen's kappa indicating a low level of compliance on the part of inspectors),
- implementation of a new standard in the work area,
- problems with standard observance at the work station.

Audit results in the form of red cards should initiate corrective action. Persons responsible for carrying out such action and the deadline for the latter should be identified. Implemented

corrective action should be evaluated in terms of its effectiveness. Kamishibai audits may also be a starting point for improvement action, as a result of which standards may be changed.

### **Board/Question list review and updating**

Kamishibai audit tools (board and cards) are dynamic tools and, as such, they should be updated to reflect changes to applicable standards (after they are changed). The kamishibai system should be subject to supervision, reviews and audits, meaning that it may also be subject to change. The most important principle is that if there is a flaw of the kamishibai system, it needs to be changed. Changes should be reviewed and recorded (depending on their originators). The kamishibai system should always be up-to-date.

### **Card/question shuffling**

In order to avoid a situation in which audits in a given audited area are carried out with the same cards and questions, kamishibai cards may be shuffled, which will result in the randomness of the scope of the audit in that area.

## **3.2. Prerequisites for kamishibai audit success and method of reinforcing their effectiveness**

Kamishibai audit success depends on several factors. Kamishibai audits may not be carried out without support from the management – managers should monitor the correctness of their implementation, support the leaders of the audited areas in the audit implementation, and they should support the employees, both the auditing and the audited ones. A basic prerequisite for the kamishibai audit success is employee training aimed at acquainting them with the purpose, form and procedure of the audit. During such training, it should be highlighted that kamishibai audits are not a form of control, that they are not aimed at punishing employees when something proves wrong, but, above all, to seek opportunities for improvement. For this form of the audit to be accepted and perceived positively, the company needs to have a mature and 'healthy' corporate culture based on 'why', not on 'who' (Miller, 2009). One of the lean systems, TQM, Six Sigma, should be implemented in the company before the kamishibai system is – this is a basic prerequisite for the system success, although it is not sufficient. Systematics, discipline and consistency are required to ensure that the system is able to last and be perceived as an important support tool in the improvement process (Niederstadt, 2014b). In that respect, an important role is played by the management who should demonstrate their involvement and support. The primary objective of the kamishibai audit is not to seek perpetrators and punish them (Miller, 2009). It is very important that everybody should understand that – kamishibai audits should not be associated with yet another action against the employees, with a system of penalties and sanctions.

In order to evaluate the effectiveness of the system (Ulewicz, 2013, p. 38) of kamishibai audits in the quality inspection process area, one may set *key performance indicators*, and

then measure them over time. Example KPI's determined with respect to kamishibai audits are as follows:

- WN – rate of audits completed with positive results (%):
  - a) Objective = 100%,
  - b)  $[\text{Number of audits with positive results ('green' cards, "green") in a specific area and period of time} / \text{Number of all audits in this area and period of time}] * 100\%$ ;
- WN – rate of positive answers obtained during the audit (%):
  - a) Objective = 100%,
  - b)  $[\text{Number of positive answers obtained during the audit} / \text{number of all (positive and negative) answers obtained during the audit}] * 100\%$ .

In addition, a suggestion system may be used. A negative result of the audit may be a starting point for the employee of the area audited to suggest preventive measures (suggested improvements), which will make it possible to increase the employees' involvement in the change and improvement process.

#### 4. Discussion

Ultimately, there arises a question regarding the advantages and disadvantages of kamishibai audits in the context of their applicability to quality inspection areas and processes. The authors have decided to investigate the problem.

Among positive aspects of kamishibai audits in quality inspection areas and processes, one should first indicate their simplicity and speed which result from the fact that they only cover a selected aspect related to quality inspection (or several points), and that they 'communicate' with their addressees visually. Other advantages include:

- low time- and labour-intensity: it takes little time to carry out an audit, and it does not take much effort on the part of the employee – auditor,
- evaluation unambiguity: because the audit is supported with visual management tools, there is no risk of 'differing interpretation' of a situation by the auditor during the audit,
- evaluation objectivity: the audit is not announced, which makes it possible to verify the actual condition within a given area (the employees are not able to prepare themselves for the audit),
- versatility: the audit may be carried out by any employee, irrespective of their position in the company (short training is sufficient), and it may cover virtually any quality inspection area and process,
- proactive, preventive function: the audit makes it possible to manage the quality inspection process, suggesting how to act in advance and prevent adverse events and

situations (the audit may implement controlling tasks (Ulewicz et al., p. 26) related to quality),

- flexibility: because of the time/time period – kamishibai audits may take several or a dozen or so minutes, and their frequency may differ; because of the place – they may simultaneously cover one quality inspection area/'point', or they may cover several selected areas (points); because of the form – cards and boards may come in various forms,
- interaction: kamishibai audits may be carried out independently, or they may be a component of other audits (for example, quality management system internal audits according to ISO 9001), or they may be a 'one-minute manager' (Johnson and Blanchard, 2011),
- further added value – because audits may be carried out by different employees, they may have different views of the problems identified as well as of the standards themselves; it ensures a 'fresh look' which may be used in the quality inspection standard and process improvement,
- improvement opportunity: the audit enables identification and elimination of deviations from standards in the area/process analysed as well as improvement of standards and quality inspection processes themselves.

Among negative aspects of the kamishibai audit implementation, one should indicate the following:

- costs of: procurement/design and development of the board and cards, training and delegation of staff, and assigning additional responsibilities to them,
- lack of acceptance: kamishibai audits may can be negatively perceived by – audited employees as yet another form of control or surveillance of employees; in addition, if they are combined with a system of punishment, they will certainly not bring about the expected tangible results,
- lack of objectivity: this may only happen when the auditing and the audited employees are personally related to one another,
- lack of knowledge and involvement: auditors not believing the audits will change anything, management not monitoring the timeliness of audits, auditors' support, substantive and financial assistance in the solving of problems and implementation of solutions,
- lack of consistency: audits may not be systematically carried out, dates of audits may not be met, corrective measures may not be specified and implemented, which is a quick way to fail.

Most of the identified potential problems related to the kamishibai audit are related to one factor – people, as it is people on whom a lot depends in the kamishibai system, it is people who create the system, and it is people who should be helped – made particularly aware of the

need to act in accordance with the standard. A culture of mutual support, understanding and involvement appears to be required for the successful implementation of these audits in the field of quality inspection processes.

## 5. Summary

The aim of the article was to prove the possibility of using kamishibai audits in the field of quality inspection process implementation. As it has been proven, kamishibai audits may be successfully applied in the field. Example kamishibai cards and audit questions have been developed that may be used in the area. It has been indicated that the implementation of kamishibai audits requires adequate preparation (training, development of the board and the list of questions...) and a lot of involvement on the part of the management. Advantages of their application exceed the initial effort and the costs incurred. Increasing the level of employees' knowledge and competencies regarding quality inspection processes and their standards in the audited areas, identification of problems and implementation of corrective measures are the advantages supporting the implementation of such audits in the field of quality inspection. Each kamishibai audit should be perceived by the employees as an opportunity for improvement. This requires ongoing communication and understanding of the audit principles by all the employees. Owing to that, kamishibai audits will constitute an important added value, and they will be an important and acceptable tool of continuous improvement (kaizen) within the company.

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