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Measuring effectiveness and suitability of a quality system

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ABSTRACT *The very premises on which ISO 9000 certification was marketed seem to have fallen by the wayside during the past 8 years. Thousands of companies across India and also the world embraced the ISO route. After a few years of togetherness with the ISO 9001/9002 system, the companies' chief executive officers are very disillusioned. Apparently, the anticipated result, 'quality improvement', has not materialized. Instead, they see only costs being accrued, and documents and records piling up. In some extreme cases, a parallel system has even materialized! The authors try to see the reasons for this sorry state and recommend a methodology for quantifying effectiveness of ISO 9000 system implementation.*

Current scenario

It is nearing a decade since ISO 9000 certification started. More than 5000 organizations must have secured the certificate thus far in India alone! In most organizations, it has been the case of euphoria first, followed by disillusionment as the years pass by. "We see only expenses but no value addition", murmur the chief executive officers. The world over, criticism is heard that ISO 9001 implementation does not improve organizational performance. An ISO 9000 survey was planned and conducted by Sri U. H. Acharya and Sri Sanjit Ray of the Indian Statistical Institute, Bangalore Centre, in 1996–97, with the following objectives:

(1) to gather ISO 9000 experiences in Indian industries;
(2) to document the benefits of ISO implementation;
(3) to identify the need and extent of training required on statistical techniques;
(4) to suggest measures for increased effectiveness of ISO implementation.

The survey was limited to those companies certified on 31 March 1995. From the information furnished by certification bodies, the number of such companies was estimated to be 1200. The survey was conducted through postal enquiries and the information provided by the respondents was assumed to be true and correct. Ninety-five per cent of companies reported that they were satisfied with the style of auditing, 2% said they were not too happy, while 3% reported that they were not at all happy with the conduct of audit and reporting of audit observations. The survey also revealed that 90% of the organizations surveyed did not have a measure for evaluation of effectiveness of the quality system. Nearly 5% of the organizations

even expressed doubt about the usefulness and suitability of ISO 9000 series standards for improvement. It is against this background that the authors conceived the ideas put forth in this article.

What is effectiveness?

Assessment of 'effectiveness' has to be linked up with organization's policy and objectives for quality and, at the same time, quality planning, which is considered to be a backbone for development of quality. A mere trend chart of number of non-conformances established during internal/surveillance audits, with a target of zero non-conformance, is hopelessly detrimental for reflecting effectiveness of any quality system.

In this paper a 'measure' is proposed (after trying it in few industries) which can be used for benchmarking and as a criterion for declaring whether a quality system is effective or not.

Definition of a 'measure'

A measure is a standard way of calculating the performance result of a work process. It describes the results in objective terms that are logical and quantifiable. A good measurement system begins with the top management's score card for measuring success and cascades those metrics to action measures used by frontline workers.

Suggested measure

Step 1

Quality policy should be translated into specific measurable objectives (should incorporate vision of the business, stakeholder's needs and expectations). Such objectives are then cascaded down to the departments as specific, measurable, relevant, time-targeted goals for the functions/work processes to aim at.

Example

Suppose an organization's quality policy is total customer satisfaction. It can be then translated into objectives of

- on-time delivery;
- fewer customer complaints;
- reduced response time to service calls/complaints.

The matrix diagram given here illustrates the cascading process of deploying the objectives mentioned to respective work processes and fixing of the targets (Table 1).

Step 2

Identify the main processes, enabling processes and monitoring processes from the activity plan and map them in terms of ISO 9001 clauses.

Table 1. *Example of policy deployment to work processes in the Purchasing and Marketing Department*

Policy	Objectives	Purchasing	Marketing
Total customer satisfaction	Improved on-time delivery	Procurement cycle time (↓)	Order filling time (↓)
	Reduced customer complaint	Rejections in shops and inward goods (↓)	No. of amendments raised by customer after order acceptance (↓)
	Reduced response time to attend service calls	Procurement cycle time for spares (↓)	Customer (commercial) complaints (↓)
			Hit rate of quotations (↑)

Example

The business areas are cascaded into work processes and then mapped with the ISO 9001 clauses. This mapping is grouped into three major categories—quality processes, main processes and secondary/supporting process. Quality processes consist of documented quality systems (4.2), document and data control (4.5), assessment of management responsibility with executive management (4.1), internal quality audits (4.17) and corrective and preventive action process (4.14). By primary/main processes, we mean the processes that yield a deliverable for the customer/client and are covered through clauses 4.3 (order administration), 4.6 (purchasing), 4.4 (designing), 4.9 (production), 4.15 (dispatching) and 4.19 (servicing). The work processes as detailed are in series to yield a deliverable to the customer. In some cases some clauses may not be applicable. Secondary/supporting processes are those which enable the main process to function better and usually performance of these processes has a desired or undesired effect on the performance of the main processes. The rest of the clauses can be considered as enablers or support processes.

Step 3

Audit is the most trusted tool for evaluating the compliance as well as continuing suitability of the ISO 9001 system. Plan the audit, by suitably selecting the functions/activities for audit, and decide how many samples shall be looked at.

Example

If we are auditing marketing process, we have to classify the processes into activities performed to deliver the marketing process output, which could be order administration, and follow up of order execution.

Now order administration consists of the following ISO mapping:

4.1 Whether the order administration process fulfils its quality objectives?
4.2 Whether there is a documented procedure of order administration process?
4.3 Whether contact review activities are done really to understand customer requirements and ensuring that the organization is capable to supply as per customer requirement and resolving any conflicts or discrepancies and amendments received for orders are acted upon or not?
4.16 How quality records are retained/maintained?

Similarly, the exercise has to be carried out for all processes.

Table 2. *Guidelines for contract renew audit*

Clause No.		Audit focus
4.1	(a)	Trend in order filling time is monitored or not?
	(b)	Number of amendments/changes are monitored or not?
	(c)	Customer complaints are monitored or not?
	(d)	Hit rate of quotations is monitored or not?
4.2	(a)	Documented procedure is available or not?
4.3	(a)	How are the customer's performance requirements and quality assurance requirements established at inquiry stage?
	(b)	Are tenders and orders treated in a similar manner?
	(c)	How are the discrepancies/ambiguities in order contracts resolved?
	(d)	How are the data circulated to all parties concerned?
	(e)	Do the data circulated provide all the necessary information for the task to be performed and verified effectively?
	(f)	Is marketing involved in any of the design and production control cycle?
4.16	(a)	Are the records kept legibly?
	(b)	Are they retained for specified periods?
	(c)	Are the data from quality records analyzed?

Step 4

Conduct the audit based on the guidelines given in Table 2 and tabulate the findings.

Step 5

Quantify the effectiveness for the objective being audited by part per million methodology by way of verifying compliance to the check-list in step 4.

Example

Let us assume we checked quotations against five enquiries and five orders which had been accepted and 10 current files pertaining to customer correspondence/communications and the results are as given in Table 3.

If each non-compliance against established procedure or applicable standard is treated as a defect, the total number of defects observed $D = 0 + 0 + 2 + 3 = 5$ and the total number of opportunities for defect $4 + 1 + 28 + 30 = 63$. It is noted that, in Table 3, either '√' or '×' are counted as these are not verified or were not applicable for the sample rejected.

Then defects per opportunity $(DPO) = 5/63 = 0.079365$; and the same is expressed in terms of defects per million opportunity $(DPMO) = 5/63 \times 10^6 = 79365$ ppm. Thus, the probability of observing a no defect situation is e^{-DPO} and from Poisson distribution it is equal to 0.9237, which is defined as yield per opportunity (YPO). Now taking DPO as the upper tail of standard normal distribution we obtain a Z value of 1.41, which can be termed a long-term Z value as the audit is conducted either quarterly, half yearly or yearly. This is abbreviated as Z_{Lt}. If we allow for shift from short term to long term then $Z_{St} = 1.41 + 1.5 = 2.91$.

The audit exercise is repeated for other value adding processes and then steps 3–5 are repeated and the results are as given in Table 4.

Overall defect per opportunity $= \log_e 0.8608 = 0.149805$ and overall defect per million opportunity $= 149805$; from standard normal distribution $Z_{Lt} = 1.04$ and $Z_{St} = 2.54$ (with the shift). The sigma level of the company is 2.54, which is much less than that of an average

Table 3. *Summary of findings of internal quality audit in the Marketing Department*

	Observations										Non-compliance established	Total opportunity for defect
	1	2	3	4	5	6	7	8	9	10		
4.1a	✓											
b	✓											
c	✓											
d	✓											
Subtotal:											0	4
4.2	✓										0	1
4.3a	✓	✓	✓	✓	✓						0	5
b	✓	✓	✓	✓	✓						0	5
c	×	—	✓	✓	✓						1	4
d	✓	✓	✓	✓	✓						0	5
e	✓	✓	✓	✓	✓						0	5
f	×	—	✓	✓	✓						1	4
Subtotal:											2	28
4.16a	✓	✓	✓	✓	✓	✓	✓	×	✓	×	2	10
b	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	0	10
c	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	1	10
Subtotal:											3	30
Grand total:											5	63

✓ denotes checked and compliance established; × denotes checked and non-conformance established; — denotes not applicable and declared as passive opportunities.

Table 4. *Summary of IQA findings for all the departments*

	ppm	*YPO*	Z_{Lt}	Z_{St}
Marketing	79 365	0.9237	1.41	2.91
Design	8 036	0.9920	2.41	3.91
Purchasing	20 380	0.9765	2.05	3.55
Production	10 030	0.9900	2.33	3.83
Despatch	1 112	0.9989	3.06	4.56
Servicing	27 481	0.9729	1.92	3.42

For overall process $YPO = \Pi(YPO)i$
$= 0.8608$

company, which is 4. The overall 'process sigma level' calculations should include supporting processes and quality processes. Now the question is whether this company should be declared as a company having a suitable and effective quality system or not. The question has to be answered by one and all today. For company certification, a regulatory body should indicate a minimum sigma level of 4 for the main processes and 3 inclusive of supporting processes.

In fact, we shall urge the organizations to demonstrate a continued quality system improvement and this continual improvement philosophy has to be deployed throughout the organization and addressed in quality policy. The continual improvement process should bring the level of a company to the 6 sigma level, when the company can be certified as capable of maintaining its own system, and a self-certification scheme can be evolved so that certification bodies can add value through audits on organizations which need them rather than organizations that have demonstrated capability of continuous improvement. This approach can help the organizations to quantity and also evaluate to what extent the process objectives are being fulfilled through implementation of the quality system.