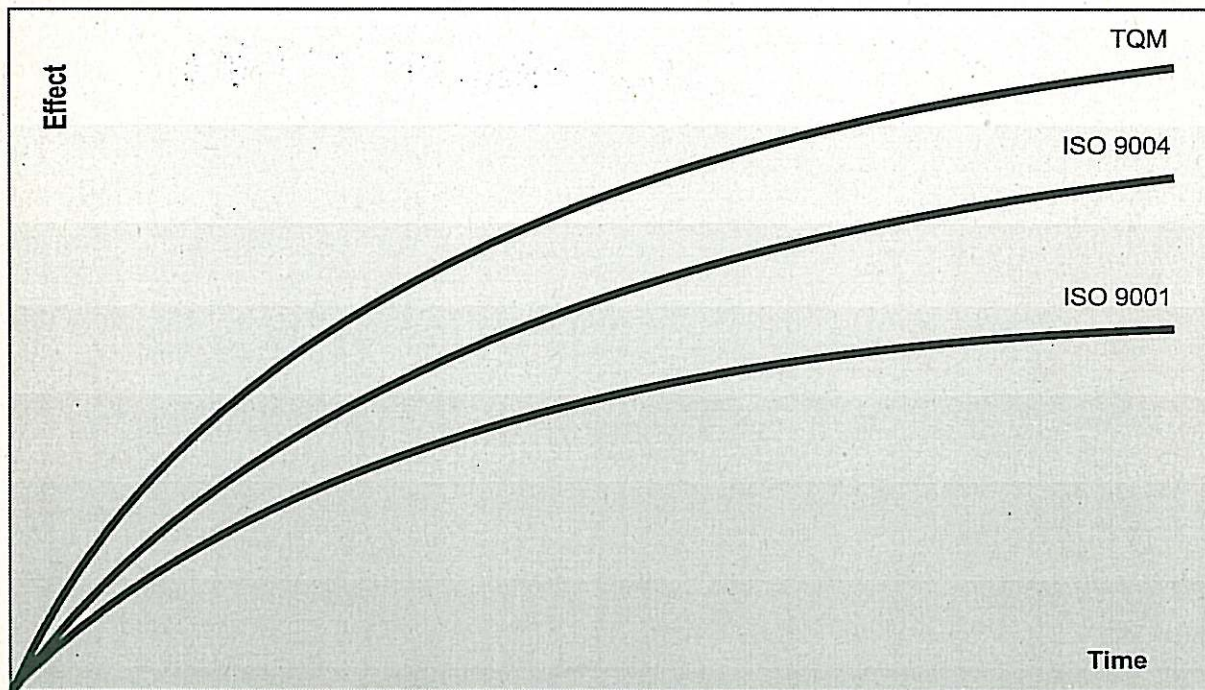


Odd Sjøholt and Antti Lakka

Measuring the results of quality improvement work



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Norwegian Building Research Institute

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**Measuring the results of quality
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Preface

Behind this report stand a group of Nordic contractors, research institutes, and colleges. In 1991 the Nordic Building Research Cooperation (NBS) work group for the Building Process (NBS-BP) took the initiative to create a group for the exchange of ideas and experience in the field of Total Quality Management. The group named itself: "Total Quality Management - TQM the Nordic Way". The main aim of the project is to strengthen the competitive ability of the Nordic building industries on an international level. Altogether 12 Nordic contractors have participated in phase 1 from 1992-93, together with research institutes and colleges from:

Finland: Haka, Lemminkäinen, Puolimatka and Finland's Technical Research Centre - VTT, with the financial support of the Confederation of Finnish Construction Industries.

Norway: Byggholt, Norwegian Contractors, Selmer, Veidekke and the Norwegian Building Research Institute with the financial support of the Research Council of Norway and Norwegian Association of General Contractors - LBA

Sweden: F O Peterson & Söner Byggnads AB, JM Byggnads och Fastighets AB, NCC, Siab, Skanska and Chalmers University of Technology, with the financial support of the Swedish Building Industry's Development Fund - SBUF.

The group has studied topics connected with TQM, and discussed these at a series of conferences. This report gives an account of the companies' experience with their search for suitable criteria for evaluating their own TQM levels. In addition, the results of the internal measurements of certain companies are presented, showing how improvements can be measured by following the course of selected indicators over a period of time.

The authors wish to thank especially the following companies for material provided for the publication: Haka Oy and Lemminkäinen Oy of Finland, Byggholt A/S, Norwegian Contractors A/S, Veidekke A/S and Selmer A/S of Norway as well as NNC AB and JM Byggnads och Fastighets AB of Sweden.

At the same time NBS-BP received financial support from the Nordic Council of Ministers for a parallel subsidiary survey of company methods and tools for the measurement of improvements and efficiency. This survey has concentrated on the measurement of results, but is based on the premise that a company must be working actively with improvements if there is to be any purpose in such measurements!

The main partners in this survey project have been the Technical Research Centre of Finland - VTT and The Norwegian Building Institute- NBI. Antti Lakka from VTT and Odd Sjøholt from NBI have collected, processed and laid forth the information now presented in the form of this report.

The report is based on examples and illustrations from the contractors' business. The principles are, however, of general validity, and can be adapted both to other branches of the building industry, and to other industries.

The report is published in Norwegian and English in the NBI's series of project reports, and in Finnish in the serie by the Confederation of Finnish Construction Industries.

The report is to be presented for the first time at the international conference on Quality Management in Building and Construction under Vision Eureka Hamar/Lillehammer 13.-16. June 1994.

Oslo, May 1994
The Norwegian Building Institute

Tampere, May 1994
Technical Research Centre of Finland

Contents

Preface.....	3
Contents.....	5
Summary	7
1. The measurement of results starts with planning and goal setting in all areas and on all levels of the company.	9
2. The measurement of results is the driving force behind the process of improvement in a company	13
3. Improvements are aimed in the first place at nonconformities (defects) and waste.....	15
4. Methods and tools for the measuring of results.....	17
5. Company examples of measured improvements.....	21
6. Company assessment of own TQM level	24
7. Vocabulary	31
8. References.....	32

APPENDIXES

1. Total Quality Management - definition and interpretation
2. A contractors internal assessment of the company as a whole
3. A contractors internal assessment of a construction project
4. A contractors internal assessment of a site

Summary

In quality development work the measurement of results is an essential part of company management's goal setting and assessment of the effects of launched development activities. Without an assessment of results, development activities remain ill-defined and the desired benefits are not attained. On the other hand, the presentation of results, whether good or bad, is a motivation for further development. Measurement should be implemented in as simple form as possible. It must be a natural part of management's normal goal-setting and review of results.

The evaluation of results is the driving force. But to measure improvements in quality and efficiency one must have a starting point from which to measure, and there must be active on-going effort to improve. The results of such measurements are only useful if they are followed up, and used in motivating and evaluating further improvement measures. The management loop *PLAN - DO - CHECK - ACT* applies continuously. The quality programme is a necessary tool for organising and controlling the process.

A company needs to measure its progress in many ways and places:

- within the various fields of the company's activity
- at the different levels of the company's internal hierarchy
- in relation to plans and aims that have descended the scale from the highest level to the individual employee
- over varying periods of time
- in relation to each development project.

To begin with, improvements are aimed at reducing nonconformities and waste. These are the areas that, in the start phase, will yield the greatest returns. With fewer deviations and errors the total productivity also increases, mostly because one reduces the snowballing effect of such errors.

Measurements may begin with the assessment of failures at handover. Later on, they can be expanded to the measurement of annual repairs under warranty and some production-period indicators measuring quality such as the realization of intermediate goals subject to penalties. External nonconformity costs measured in economical terms are also a clear indicator of quality.

This report gives several evaluation criteria for each of the above mentioned areas. In practice a company must select just a small number of these criteria in order to assess its development, and apply them over a longer period of time. It will also need to select criteria for the supervision of individual projects, and, in addition, criteria that are to be used over a shorter period of time in connection with defined and limited improvement measures. And finally, personal indicators may also be relevant.

The report gives many examples of *evaluation criteria* for each of the above mentioned areas. Such selected criteria are used to set periodical aims for improvements, and to give a continuous indication of how successful one is in fulfilling those aims.

Once the work with improvements is under way, the measures can be extended to include new products and processes, and in addition to analyse the organisation as a whole in the light of the concept of total quality management - TQM. The report also describes a tool for the evaluation of the company's TQM level. On the basis of the

quality criteria , there has been designed a simple form for the awarding of points in order to evaluate:

- a) a construction company
- b) a building project
- c) a building site

The companies' conclusion from their trials with this system of evaluation was that first and foremost it gave a good indication of which areas of improvement should be followed up by special measures. It also appears to be a good tool in aiding the top management to appreciate how the concept of TQM affects management in practice. The report also gives summaries of a few of the participating companies' evaluation of the system.

1. The measurement of results starts with planning and goal setting in all areas and on all levels of the company.

Below we describe some of the basic elements for the development of a measuring system.

The management loop is the basic principle for all learning and development. Automation is based on regulation techniques (cybernetics). The equivalent of this in the context of quality is the management loop, the so-called Deming Cycle: *PLAN - DO - CHECK - ACT*. This management loop is used more or less formally, to achieve many different goals, on all levels and areas within a company or organisation. The four basic concepts, however, vary in content according to the objective, *fig. 1*.

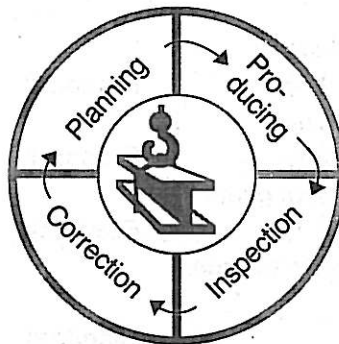


Fig. 1. Taking measurements in the absence of planning and goals is pointless.

The total scope of the company or organisation's activity within the building industry or individual building project will decide how broad or comprehensive it can or should make its measurements, *fig. 2*:

- *Main areas:* programming, design, factory/building site production, facilities management
- *Office staff areas:* sales, budget and finance, personnel, equipment

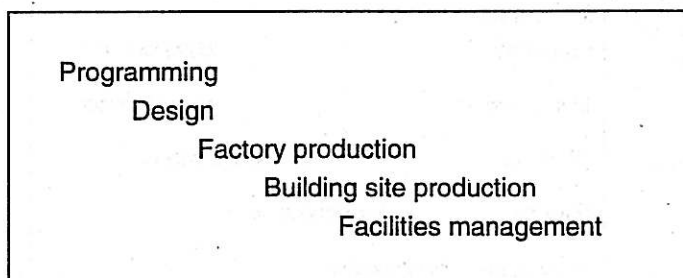
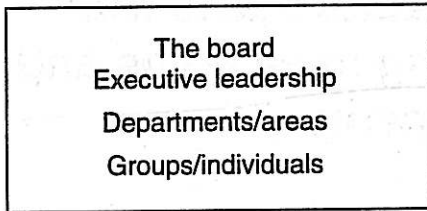


Fig. 2. The company makes measurements within its own areas of activity.



The level of responsibility within a company or organisation is a usual starting point for setting measurable goals and measuring results, fig. 3. The hierarchy of goals can aim at e.g. the executive leadership, the departments or areas of activity, or at individuals.

Fig. 3. Measurements and results follow the company's hierarchy.

External and internal customers' demands and needs must be defined at all levels.

The company or organisation is steered in accordance with long term plans (visions, policies, long term objectives) that are broken down into detailed short term plans and goals. Ideally, improvement goals are found throughout the company or organisation. On the way down the hierarchy from the top management (highest level) to the individual worker (lowest level) the objectives are concretised and transformed from long term and difficult to measure to short term and easy to measure, concrete and direct [1], fig. 4.

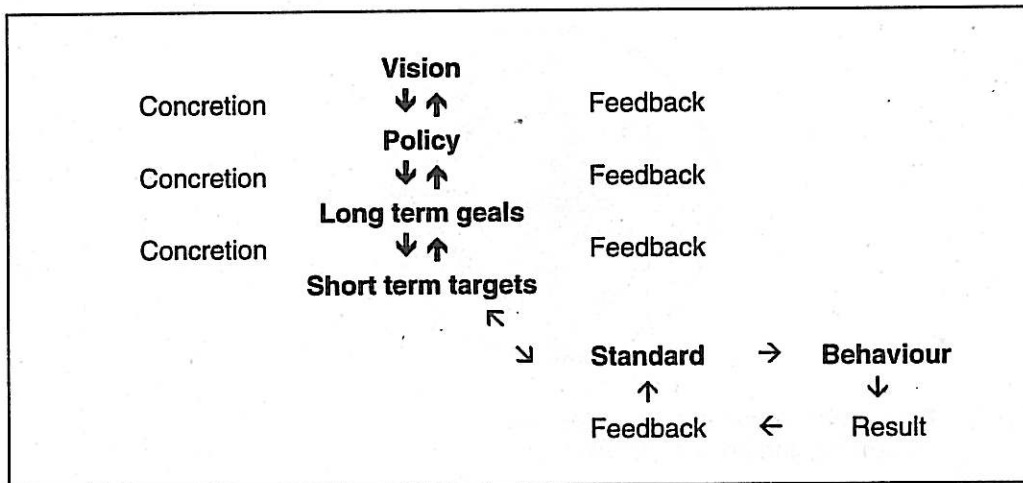


Fig. 4. The objectives are made concrete, and the results are fed back.

The measurement of results in relation to planned objectives must be carried out on many organisational levels, and in varying time perspectives (periodical measurement and trend analysis).

Long term: annually or quarterly

- for the company as a whole, or for main areas of activity or main resources
- for comparison with other companies (benchmarking)- a rather special case
- for simple indicators that show some specific development or improvement.

Middle term: monthly

- for main areas, departments, projects or building tasks

Short term: weekly or daily

- for work tasks and standard activities

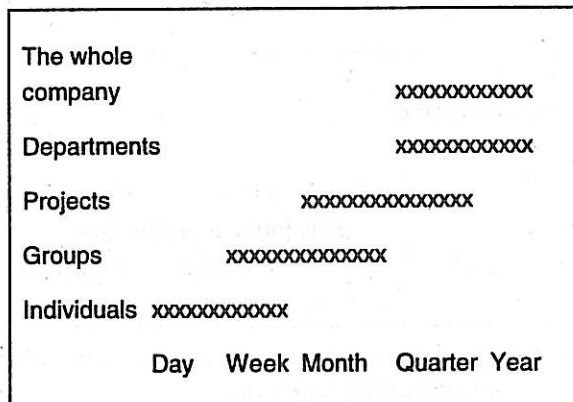


Fig. 5 The measurements are taken at varying times, according to the level

Personal performance can also be defined and followed up, for example every 6 months. Performance indicators can be bound either to processes or to activities. The supplier provides the defining information in advance, while the customer assesses the result afterwards. This applies both to internal and external supplier/customer relationships. To what extent the customer's demands are met can be measured by the use of a few main criteria. The process is supervised, and can be assessed through a few controlling parameters. The resource consumption of the process must be evaluated according to whether the resources are used correctly, and is also measured by indicators, *fig. 6*.

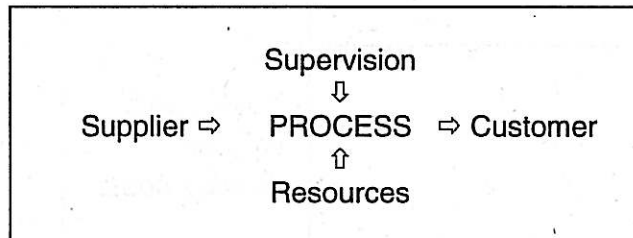


Fig. 6. Measurements are taken in relation to the connected subsidiary processes.

The traditional view has been that it is possible to determine optimal quality costs, *fig. 7*, and that there is no advantage in improving operations beyond that point. This is due to the fact that costs of prevention and monitoring increase sharply the more perfect the goal. According to modern quality thinking, developing operations on the basis of experiences from an earlier mode of operation and by introducing new methods always offers possibilities for improvement of operations and lower total costs. Thus, there is no optimum level beyond which it is not worthwhile improving operations. Total quality management aims at such continuous development of operations, *fig. 8*, [2, 3].

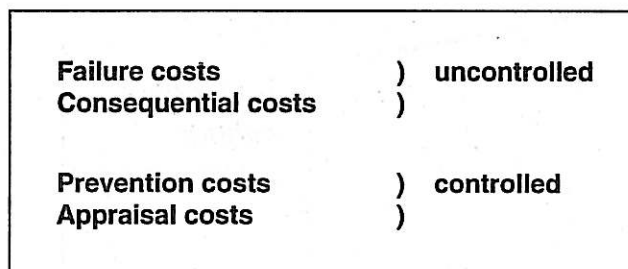


Fig. 7. Quality costs, traditional definitions

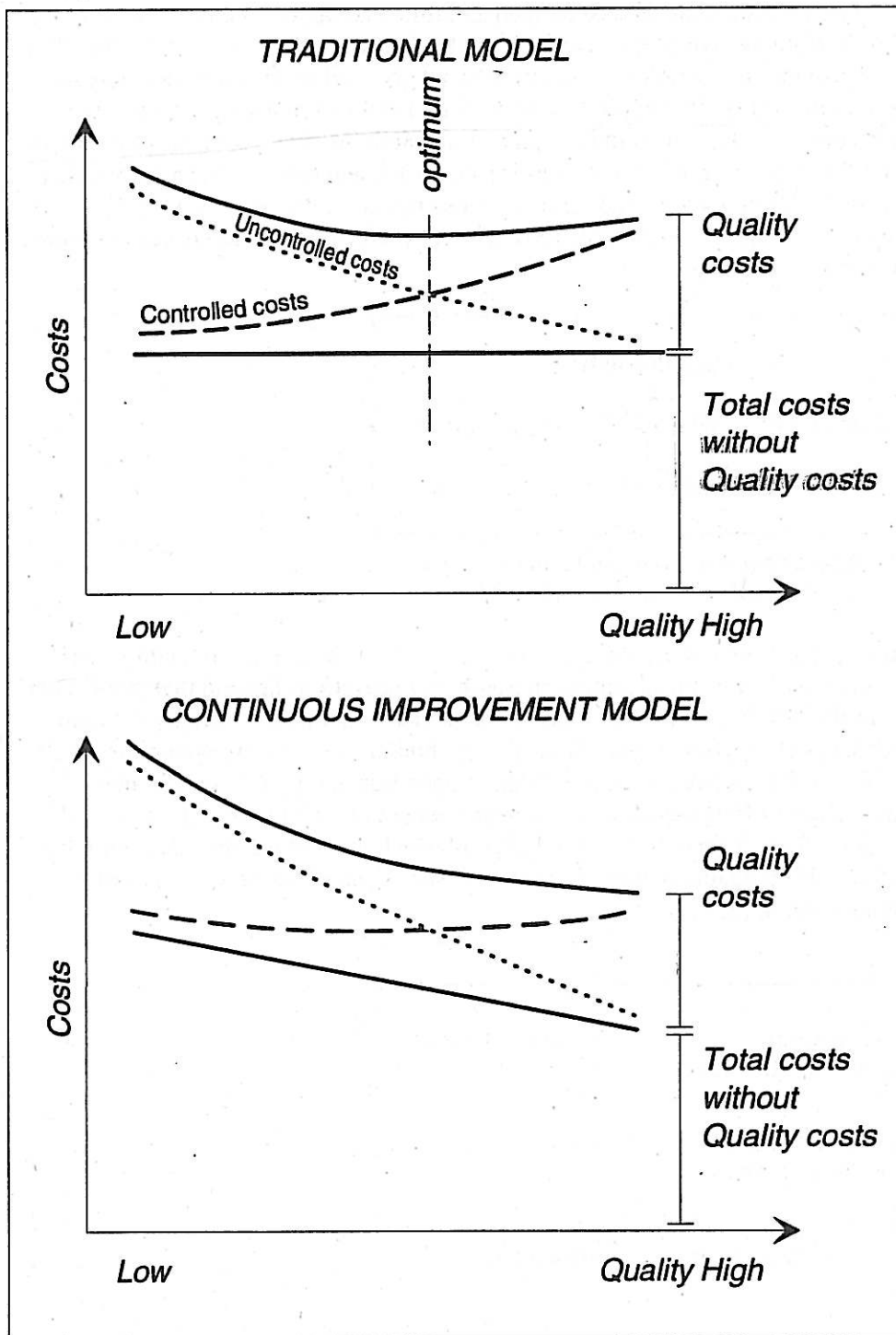


Fig. 8. Quality costs consist of uncontrolled and controlled quality costs. Through TQM total costs can always be lowered by improving operations.

2. The measurement of results is the driving force behind the process of improvement in a company

The definition of Total Quality Management TQM [4] gives the visions and the basis for a company's quality policy. The company itself must concretise and communicate its aims to all levels and all employees. The vision is that the company continuously works with improvements in quality- i.e. fulfilling of the customer's demands and needs.

Quality management involves organising, supervising and following up improvement work. This work can be steered through a quality programme which shows, at any given time, what the top priorities are. A permanent management group (quality group) defines the framework for an area of improvement, and delegates tasks to an ad hoc group with responsibilities, time limits, and provisional aims. The Demings cycle: *PLAN - DO - CHECK - ACT* is put into practice. A structured system, open for full participation, can give better results than individual, uncoordinated measures [5, 6, 7].

The first task is to identify the areas of improvement potential, and decide which tasks will receive attention. Then the process of developing new and better solutions can begin. When these have been thoroughly discussed, the next stage is to integrate the new solutions into the existing system and, at the same time, set concrete targets over a defined period of time. Finally one must develop a method for assessing the results. This latter is important, since all measures are more successful and more effective if one has set a goal and can assess results.

Plan

An important factor, both at the start phase, and later when the process has been integrated, is how to promote suggestions for improvements on all levels of the company. To do this, we make use of the methods already established for the measurement of results in the company.

- 1 Besides the continuous feedback of reactions and views of the individual employees, the company could introduce a systematic reporting of deviation and waste, and other systems for reporting and keeping statistics. Deviation reports and corrective measures are a central element in any quality system.
- 2 Quality audits will reveal any factors that could be improved (internal, external, certification). Quality audits can also be used to measure the progress within chosen improvement areas. Internal quality audits are the management's tool to ensure that the quality system is working effectively, and to find out where improvements should be developed.
- 3 Another method for finding areas that can be improved for the whole or parts of a company, is to use brainstorming. This gives the opportunity for all employees to participate, and to find areas that are of practical use to the individual.
- 4 Self evaluation based on the criteria for some or other quality prize can lead to new possibilities. Here particularly, one's attention can be drawn to a possibility one traditionally has not thought about.
- 5 Finally, a systematic comparison with other companies that are especially efficient can give rise to good ideas. (Benchmarking).

Usually, these suggestions are collected in and sent up to the most appropriate operational level for priority ranking, and the decision is then taken as to whether and where improvement work should start. It is a good rule to begin with the goals that are the easiest to achieve. The main criteria for priority ranking to begin with could be:

- It must be realistically possible to carry out the task within a relatively short time (say, 3 months).
- The task must apply to some important aspect of the business, not something peripheral and "harmless".
- The task may very well be aimed at reduction in deviation and waste.
- The task may very well be something urgent, or something that has been broached several times.
- The task must be able to be limited, and divided up into small, concrete elements that are lucid, and small enough to tackle.
- The task should present a challenge, but should not be so difficult that it is unrealistic, and the necessary skills and knowledge must be present.
- The task should, in its entirety, involve several types of employees, and be suited to group action.
- The task should be achievable within the group's area of authority.
- The task must be expected to give a result that will profit both the participating employees, and the company as a whole.
- The task must be aimed at some goal that can be achieved within relatively short time.
- The goal should be something that can be counted or measured, and the value does not necessarily have to be directly convertible to money.

Do - check - act

During the process of developing solutions one can make use of many techniques and tools [8]. The most important thing is to ensure that all the experience and knowledge contained within the sphere of those involved are fully utilized. In the same way, integration of solutions must be carried out by those who will be affected, and will profit from them. After the execution of the improvement measures it is important to document the results, and spread the information throughout the company, so that everybody understands that the effort paid off. Once the first goal is achieved, one can increase demands, and move the goal a little further. At the same time, the company management on various levels, and the quality group, must evaluate the results and decide on the next priorities for the attention of the quality programme. The management loop is thereby carried out in accordance with Demings Cycle.

In the following chapters of this report, the main emphasis is place on the classification of various types of improvement measures, and give examples of the range of methods one can select from when one wants measurable results.

3. Improvements are aimed in the first place at nonconformities and waste

When a company starts up with a quality programme for improvement work, it is often most profitable in the beginning to choose measures to *avoid* deviation and waste, and bring all forms of loss under control. When one has reduced the breadth and variety of deviations and errors, one has at the same time contributed to the increase in the total productivity, because one has reduced the consequences of snowballing. Later in the work with improvements, there is room to focus on what one can *achieve* in terms of new developments, and improvements on all levels of the company. Here, the framework of TQM can give new impulses.

The avoidance of nonconformities and waste

The deviations one wishes to avoid are deviations of quality of both product and process, both quantitatively and qualitatively.

- *Quantitative deviations from external and internal demands:*
 - nonconformity reports
 - complaints from the customer
 - complaints to the supplier
 - rejection, scrapping, lowering of classification
 - guarantee work
 - insurance costs
- *Qualitative deviations*

The waste one wishes to avoid are waste, consumption, and wear and tear of all types of resources.

- materials, wastage, spillage
- equipment, wear and tear, durability, maintenance, capacity exploitation
- work hours, waiting time
- work environment, time present, time absent, injuries, inspection comments
- calendar time, consumed, planned
- capital, interest costs.

The achievement of new developments and improvements

Once the work with improvements has got started, priority can also be given to improvement measures for new developments, and for the measurement of what one wants to achieve.

The development of new and improved standards for production and process:

- products that fulfil a function better, or fulfil new functions
- processes that utilise another technology or new knowledge

The goals can be based on Juran's Product features, and quality characteristics [9]:

- technological: hardness, acidity etc.
- psychological: taste, appearance etc.
- time orientated: durability, ease of maintenance
- contract considerations
- ethical considerations

With the customer/consumer as reference point, the goals can be based on to suitability for use:

- availability, durability/reliability, ease of maintenance, ease of production

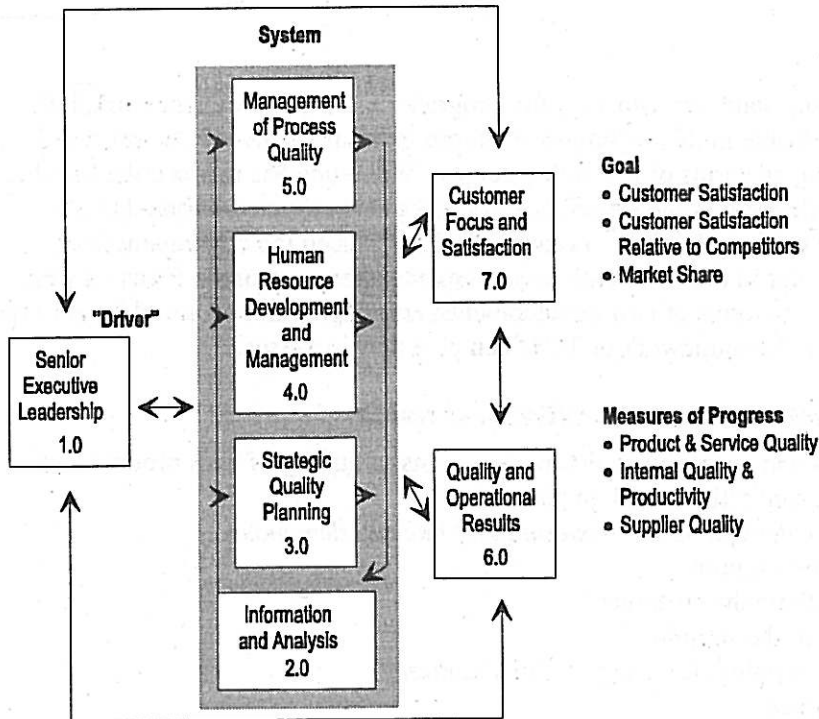


Fig. 9. Malcolm Baldrige award criteria framework with dynamic relationships can be used for self evaluation.

Priority is given, to an increasing degree throughout the improvement process, to the improvement of the company as a whole, under the concept of total quality management. The cycle *PLAN - DO - CHECK - ACT* is still followed. And it is still vital to measure results, e.g. for:

- the development of the management, the employees, the suppliers and of customer relationships [10, 11].

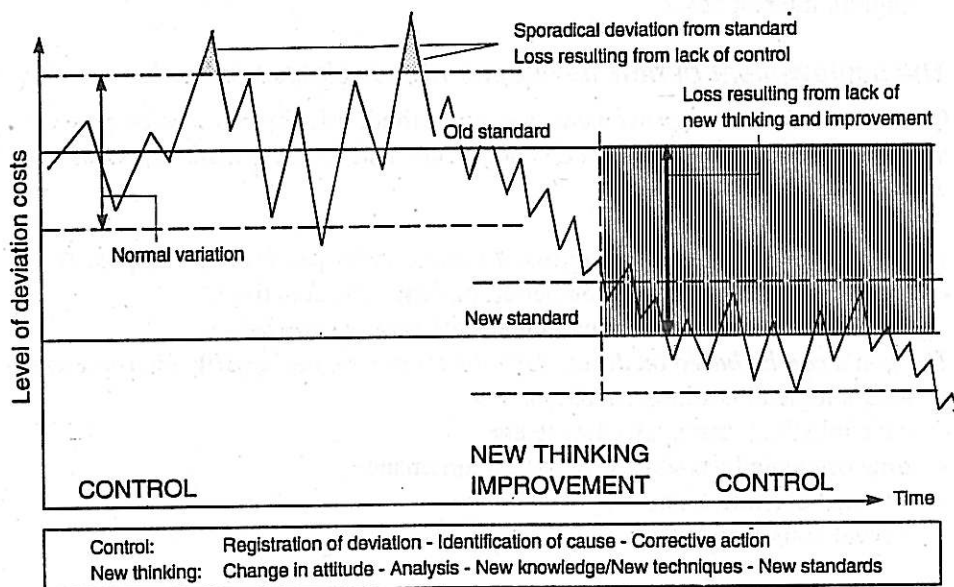


Fig. 10. Quality control reduces losses related to a certain standard method. Improvement actions are necessary to gain the benefits of better standards.

4. Methods and tools for the measuring of results

In practice a company must select a few, simple assessment criteria. The following up of the budget and costs through the accounts is normal, but gives too many figures to relate to, and usually comes too late to affect the result along the way.

The collective concept of quality costs is also much used. The aim is to reduce the costs of deviations and errors by focusing on preventive measures and control. It is seldom that such costs and savings can be registered directly in financial terms. Instead, one has to measure other parameters that can either give a sufficiently clear picture of the improvements, or can be translated into monetary values, see table 1, 2 and 3.

Determined by the area under improvement, goals are worked out, and solutions are developed and integrated. These could be new methods, new forms of co-operation, new procedures, new inspections etc.[12, 13].

Table 1. Improvements and measures aimed at reducing nonconformances

Problem	Avoidance aims	To be measured	Source of information	Resp	Time
deviation from something	minimise deviation	number of deviations	deviation reports	1-5	1
error in delivery	minimise errors, damages	no. deliveries without errors/no. deliveries	complaints out	3-4	3-4
much error correction	fewer correction costs	extra hours/suppliers	invoices in	3	3-4
error	error at final inspection	no. errors at final inspection	final inspection report	3	4-5
wrong invoicing	minimise wrong invoicing	no. credit notes/total no. invoices	credit note counts	3-4	4-5
customer complaints	minimise complaints	no. customers that complain /total no. customers	complaints in	1-4	3-5
customer complaints	minimise complaints	no. complaints/total no. dwellings	complaints in	3-4	3-5
customer complaints	minimise complaints	no. complaints per project	complaints in	3-4	3-5
complaints to suppliers	minimise complaints	no. deliveries with complaints/total no. deliveries	complaints out	1-4	3-5
changes in drawings	minimise drawing problems	no. drawings with changes/total no. drawings	drawing lists	3	3-5
changes in commission	minimise changes	no. orders for changes per project	change orders	3	3-5
rejections, scrappings	minimise rejections	no. rejections/total no. produced	shift report	1-4	1-4
lowering of classification	minim. lower classifications	no. lower classifications per product	shift report	1-4	1-4
work environment	minim. annotations	no. annotations per project	annotations from authorities	3-5	4-5
calendar time	deviation from contract	% projects handed over on time	comments from cust. (day fines)	3	5
guarantee work	minimise guarantee work	guarantee costs/project costs	accounts	3-4	5
guarantee work	minimise long term defaults	costs for repair work within 10 years	accounts	4-5	5
insurance costs	minimise insurance costs	insurance costs per project	accounts	5	5
lack of documentation for goods	avoid late sending of documents	no. late sendings	no. reminders	3-4	4-5

Responsibility (level) = 1 Person, individ, 2 Group 3 Project, 4 Area/department within the company, 5 Top management
 Time (frequency of check) = 1 per day, 2 per week, 3 per month, 4 per quarter, 5 annually.

Table 2 Improvements and assessments aimed at reducing wastage

Problem	Avoidance aims	To be measured	Source of information	Resp	Time
wastage of materials	minimise spillage/wastage	% material wasted	special survey	1-4	3-4
equipment, wear and tear	increase useful life	useful life	machine register	4	5
	error on delivery	no. errors/total no. delivered	register of returns	3-4	4-5
	increase capacity utilisation	hours in use/total no. hours	machine report	3-4	4-5
shared tools disappeared	reduce time spent searching	time spent searching	man hour schedules	1-3	3-4
man hours	minimise lost man hours	productive time/total time	man hour schedules	2-3	3-4
	minimise time spent waiting	waiting time/ total man hours	man hour schedules	1-3	2-4
	fewer small purchases	no. small invoices/total no. invoices	invoice statistics	3-5	4
	minimise deliveries of missing parts	no. such extra deliveries/total no. deliveries	delivery notes	3-4	4-5
	reduce "tender blitzing"	no. tenders received/no. tenders handed over	tender statistics	4-5	4-5
work environment	increase time present	days of absence per million man hours	absence statistics	3-5	4-5
	minimise injuries	no. injuries per million man hours	injury reports	3-5	4-5
	minimise injuries	no. days injury absence/total no. days work	absence statistics	3-5	4-5
calendar time	fulfil plan	% "milestones" passed on time	site journal	3	4-5
	fulfil plan	% drawings delivered on time	drawing schedules	3	4-5
	dissatisfied customers	no. days from complaint to correction	complaint forms	3	1-2
capital	minimise interest costs	no. days from job executed to invoice	invoice report	3-4	3-4
	minimise loss from claims	loss from claims/total turnover	accounts	4-5	4-5

Responsibility (level) = 1 Person, individ, 2 Group 3 Project, 4 Area/department within the company, 5 Top management
 Time (frequency of check) = 1 per day, 2 per week, 3 per month, 4 per quarter, 5 annually.

Table 3 Improvements and goals aimed at new developments

Problem	Achievements aims	To be measured	Source of information	Resp	Time
customer satisfaction	marketing help	degree of satisfaction	customer question sheet	3-4	4-5
customer satisfaction	marketing help	degree of satisfaction	feedback meetings	3-4	4-5
supplier satisfaction	will to co-operate	degree of satisfaction	feedback meetings	3-4	4-5

Table 4 Improvements and goals aimed at TQM

Problem	Achievement aims	To be measured	Source of information	Resp	Time
better company as whole	company on a level with quality awards	choice of criteria	TQM-assess. a) company level	4-5	5
better project	project on a level with quality awards	choice of criteria	TQM-assess. b) project level	3-4	4-5
better building site	building site on a level with quality awards	choice of criteria	TQM -assess.c) building site	3-4	4-5

Table 5 Improvements and assessments aimed at comparison with others - benchmarking

Problem	Achievement aims	To be measured	Source of information	Resp	Time
efficiency in relation to others	exploit other's knowledge	own methods in relation to others	benchmarking	3-5	4-5
high customer satisfaction	marketing help	degree of satisfaction	market survey	3-4	4-5

Responsibility (level) = 1 Person, individ, 2 Group 3 Project, 4 Area/department within the company, 5 Top management
 Time (frequency of check) = 1 per day, 2 per week, 3 per month, 4 per quarter, 5 annually.

5. Company examples of measured improvements

The general requirement for measuring the results of quality development work is that the indicator should be simple to use. It is good to have as a source of data some document already in use which is not created specifically for quality measurement. It should also be possible to incorporate the measurement routine into the line organization tasks as part of normal reporting.

Four indicators of actual companies and the results they yielded are presented below. One of them measures the functioning of the internal client relationships of the company and two measure the quality of the end product and customer satisfaction. Companies should also have indicators to measure the quality of production proper already before handover.

5.1 Reliability of deliveries from equipment depot

Company A has set the strategic goal to improve their production process. Its means of developing the production process was to improve the manageability of production, for instance, by minimizing the problems in internal client-relationships. One set goal was to minimize the disruptions in the deliveries of the equipment depot that serves construction sites. The realization of the goal was measured by registering the flaws in the deliveries of the equipment depot. These could be divided into the following groups: badly timed delivery to site, improper content of delivery, defective piece of equipment and incorrect number delivered, *fig. 11*.

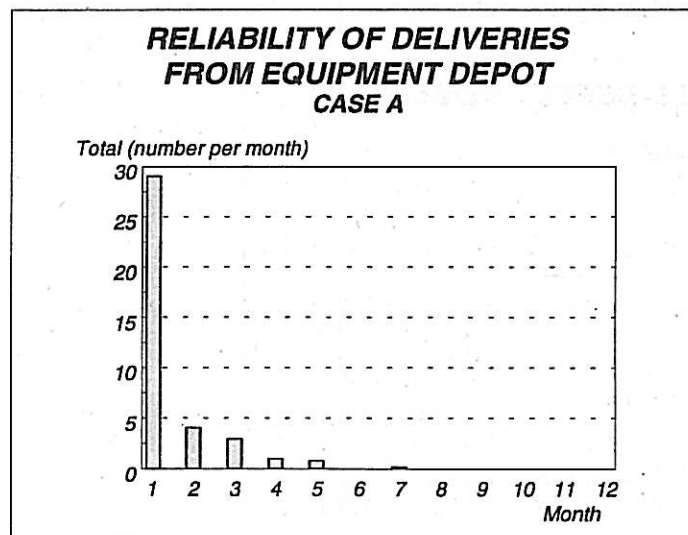


Fig. 11 Reliability of equipment depot's deliveries, case A

5.2 Fulfilling of the internal production planning requirements

Company B has set the strategic goal to improve their production process. Its means was to raise the general level of production planning. Company put an internal requirement for the level of production planning which must be fulfilled in all projects. The goal is that 100 % of the certain plans must be worked out in all

projects. The realization of the goal is measured by registering all production plans during internal audits, *fig. 12*.

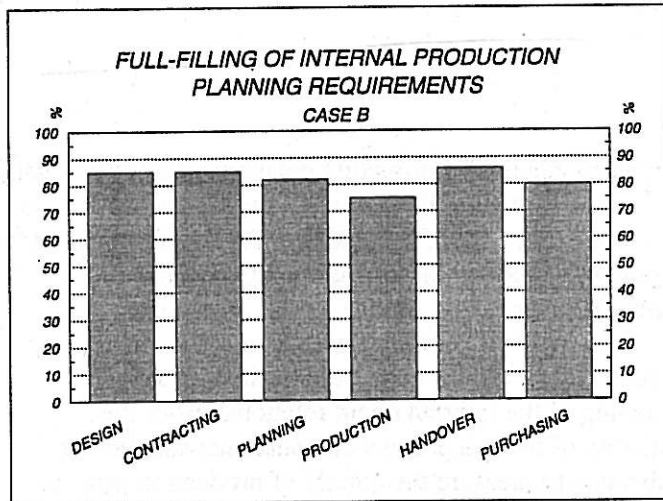


Fig. 12. Fulfilling of the internal production planning requirements, case B

5.3 Handover of dwellings free from failures

Company C has set the strategic goal of 100% customer satisfaction. Complete customer satisfaction has been translated into detailed quality goals: it must be possible to hand over dwellings to customers at the agreed time and free from failures.

The quality goals of company management are measured in each project as part of the normal handover routine. The customer's comments on the dwelling at handover are registered in the case of each dwelling. When the measurement was launched a goal of 10% of failure-free dwellings was set. The goal has been increased annually so as to bring the present goal up to 50%, *fig. 13*.

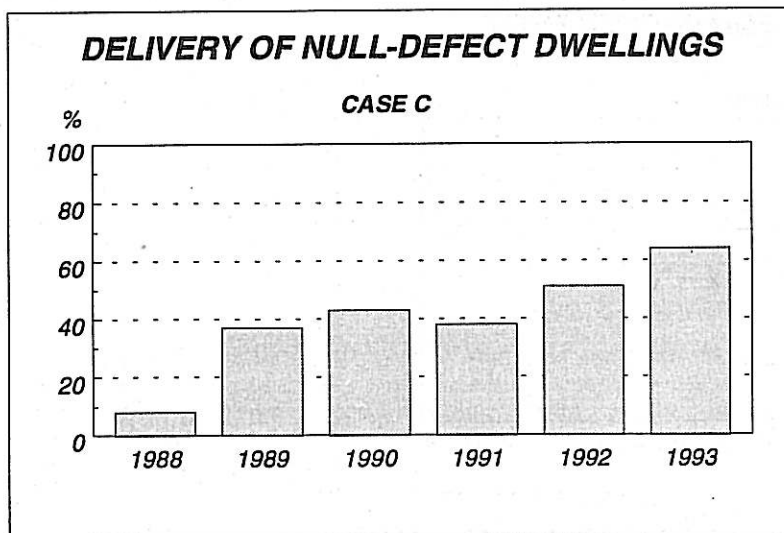


Fig. 13 Dwellings handed over free from failure, case C

5.4 Customer satisfaction

Company D set itself the strategic goal to improve their image as a quality company. The goal was translated into quality goals, one of which was to improve customer satisfaction in housing production. The realization of the goal is measured by a customer interview targeted at each occupant who has received a dwelling. The

interview asks detailed questions about how the customer has perceived the service. In addition, it asks them to assign the company a "school grade" from 4 to 10, *fig. 14*.

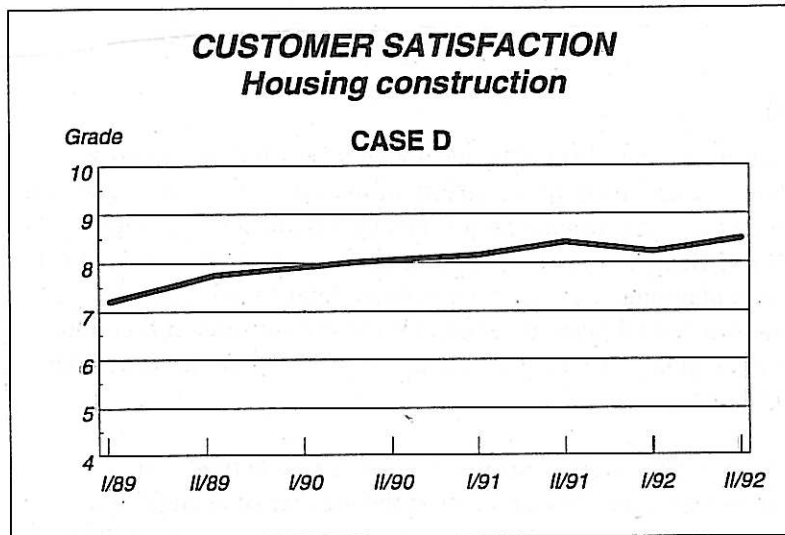


Fig. 14 Overall grade for company by customers, case D.

6. Company assessment of own TQM level

6.1 Background

The quality of an operation can be measured by the above means indirectly using indicators that are known to correlate with the quality of the activity. For instance, the quality of the planning project for a turnkey project can be assumed to correlate directly with the number of change orders: if the customer's needs are not analyzed at the start of the project and planning goals are not carefully determined, there will be numerous instances where accepted planning solutions already considered final will have to be altered which again impairs the progress of the planning process and later even the production process.

Indirect indicators of the quality of operations may, however, guide them in an undesired direction. For instance, the measurement of the number of changes in a planning project may lead to concealment of changes normally associated with the development of a plan and even to a prohibition against changes. On the other hand, an indicator based on the criteria of quality awards is a comprehensive indicator of the quality of operation that does not as easily lead away from the original goal of developing the quality of the operation.

6.2 Tools of internal assessment

Finland, Norway and Sweden have their own national quality awards that are all based on the American Malcolm Baldrige quality award (MB). An eighth area of assessment, Societal impacts, has been added to the Finnish quality award, for instance, but in other respects it is quite similar to the MB. The MB and a European quality award are used in the Nordic countries in addition to national criteria.

In connection with the Nordic TQM, The Nordic Way, cooperation, criteria (TQMNW criteria) suitable for internal assessment were developed for construction company operations and they were tested in companies during 1993. One strength of TQMNW criteria is that they are the only known evaluation criteria translated into the "language of the construction company". Some companies used the criteria of national quality awards in their tests; their strength is that they are better known. Detailed series of questions were recognized as the strong point of MB.

TQMNW criteria consist of three assessment forms whose sets of questions have been developed for the following purposes (appendices 2, 3 and 4):

- (a) assessment of the entire company (suitable, for instance for an areal unit)
- (b) assessment of a building project from start to finish (suitable eg. for a turnkey project as it also includes planning and subcontracting)
- (c) assessment of the building site.

The sets of questions are mainly based on MB, but an effort has been made to adapt them to the needs of the contractor. Set (a) is much alike that of MB, set (c) is based on the development work of Swedish contractors and set (b) is a combination of the preceding two.

A company may assess itself by filling in each of the sets a, b and c. The sets suggest a scoring system in the way quality awards do, with a total of 1,000 points to assign. One should, however, remember the the absolute score is not the most important factor from

the viewpoint of the company, but the benefits it reaps from the assessment process, *fig. 15:*

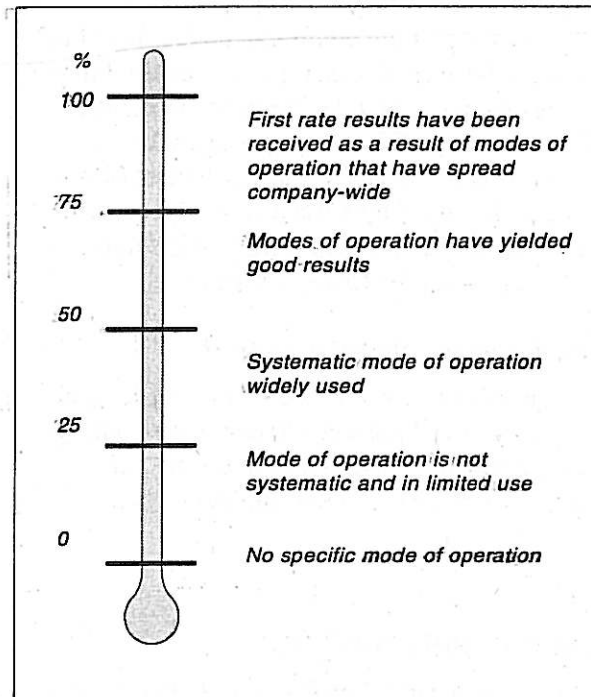


Fig. 15. Instructions for scoring TQMNW criteria

6.3 Mode of implementation

It is easiest to start internal assessments of the company by way of a single project. The actual assessment is done by asking key project personnel for their personal evaluation of the state of the project by answering questions related to it. The problem is that the respondents do not know how the posed questions apply to their specific site. Therefore, it is not worthwhile expanding internal assessment throughout the entire company before uniform guidelines or specifications concerning the things asked about have been worked out. *Table 6* shows the specifications of a company for targets of assessment that the company developed in connection with the test-assessment of the first site as an aid for assessment proper.

Table 6 A specification of TQMNW form (c) Site

3. QUALITY PLANNING AND SYSTEMATICS	60	0%	25%	50%	75%	100%
<i>a. Quality plans for sites</i> - quality plans for site have been prepared - quality assurance plan for certain work phases has been prepared						
<i>b. Quality plans have been followed and updated</i> - quality plans have been followed - quality plans related to certain work phases have been prepared and followed						
<i>c. A quality development project has been prepared and followed</i>						
<i>d. Use of production control tools</i> - master time schedule is utilized and updated - work phase schedules have been drawn up - weekly planning - realization of target assessments is monitored						
<i>e. Quality reports</i> - separate quality reports for different work phases (technical and operational)						

6.3.1 A spreadsheet-based computer application as a tool

The assessment can be made in a meeting where the group's assessment is made by assigning direct point values which eliminates the need for summing up points. In case each assessor scores independently, processing of the points can be facilitated by a spreadsheet application. The points awarded by each assessor are then entered into the spreadsheet and the application computes the mean and deviation of the points. The same principle may be applied to the assessment of the entire company by considering the results of individual projects as components of the assessment of the entire company. Then, the company must decide what weight (coefficient) it assigns to the results of projects as part of overall company assessment. The projects may account, for instance, for 20% of the total points awarded to the company.

6.3.2 Computer program developed for assessment as a tool

Commercial computer software that facilitate assessment and processing of the results are available. The programs incorporate quality award criteria whereby their contents correspond, for instance, to the MB set of questions. In addition to questions, the program may also offer space for the user's own information that supplements the criteria.

6.4 Internal assessment versus quality auditing

Internal assessment based on quality award criteria can be used as a tool of company management in a fashion that resembles internal audits to a certain extent - both constitute an act of learning and provide management with data on the effectiveness of the quality system and the functioning of the organization. Internal assessments cannot, however, replace the internal quality audits of a company.

Quality audits are necessary to ensure the introduction and effectiveness of a company's quality system. They are also independent of the target of assessment which makes the results of various projects and units comparable. Internal assessment is more subjective by nature and the applied scale varies by person. Even the same person applies a different scale in successive internal assessments. Since quality consciousness has not yet reached a high level, a certain level of performance is naturally assessed higher than its actual level. Criticalness increases along with improved quality consciousness and the next time around a person may give a poorer assessment even of a better performance level.

6.5 Results and benefits

The assessment process is a useful tool in developing the cooperation between various parties. It provides a means of bringing different organizational levels together to discuss and develop things which each party influences without being aware of the viewpoints and needs of the others. The company actually reaps much of the benefit from internal assessment already during the assessment process.

As the assessment is made by the key persons of the target of assessment, it leads them to think about possibilities of developing their own work. The results of assessment should not, however, be disseminated carelessly to outsiders in order to prevent genuine search for development opportunities from turning into covering up of mistakes, *fig. 16*.

ADVANTAGES

- the assessment process in itself is beneficial
- it points out targets for development
- it offers an opportunity for constant measurement of performance quality
- it focuses attention on process measurement instead of economic indicators

POSSIBLE DRAWBACKS

- one must be critical and not wait for an exact result
- focuses attention on matters considered important

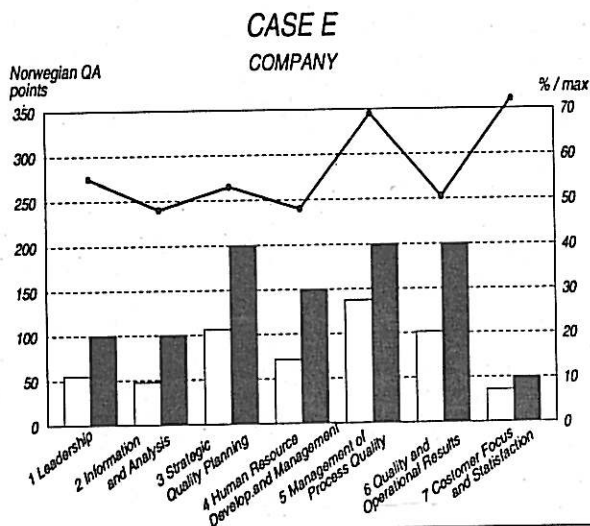
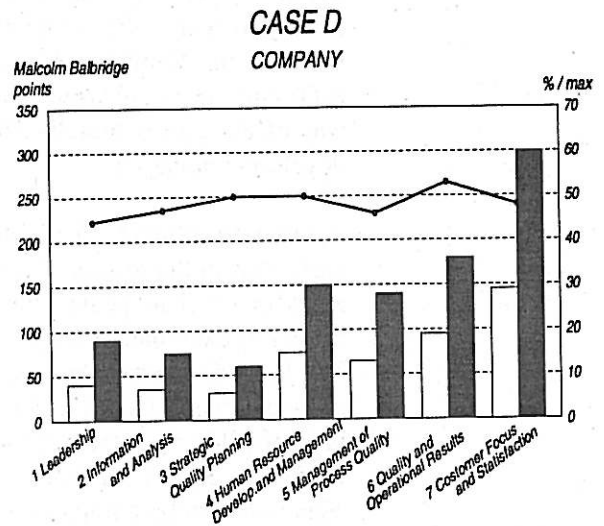
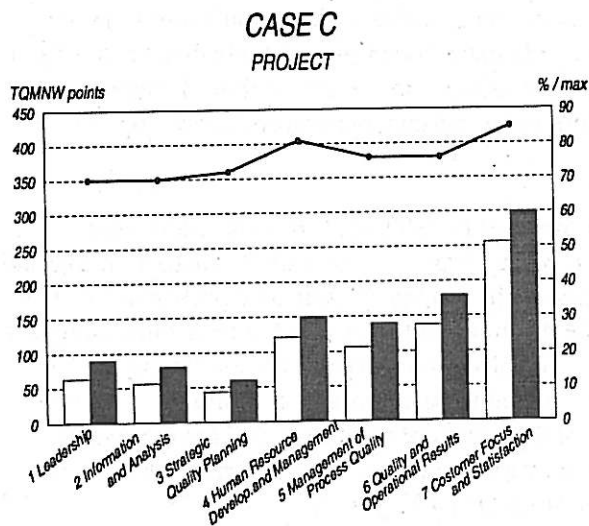
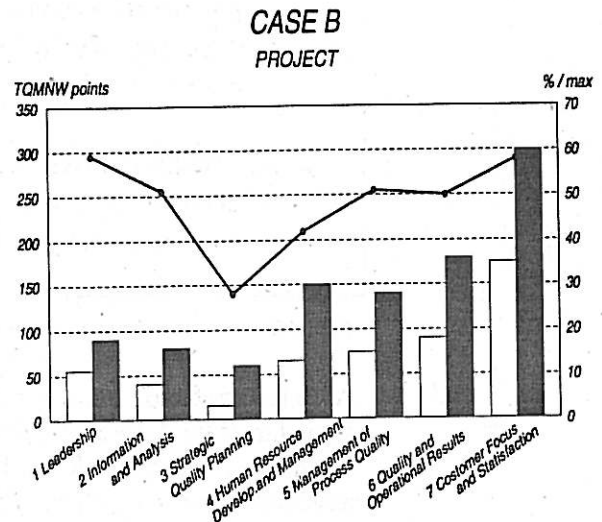
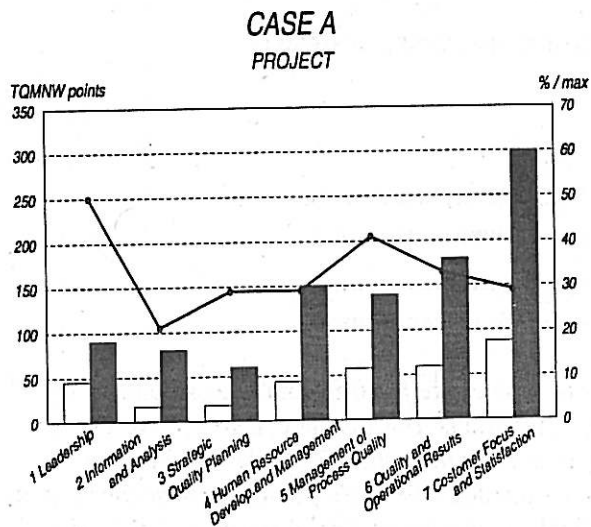
Fig. 16. Advantages and drawbacks of internal assessment

An interesting side of the results of assessment are the different assessments of the same target by different persons or organizations. For instance, a site where the customer demands quality assurance in accordance with ISO 9001 standard may be assessed lower than others. This is not a result of the site's poorer performance quality but of key persons who are more critical concerning quality. Correspondingly, the quality manager of a company may assess its customer-orientation lower than, for instance, the managing director. The wide deviation in assessments gives cause for a follow-up question: why? Comparison of assessment results or their deviation in this way offers a good source of data for revising misconceptions and searching for development targets.

Internal assessments in TQM/NW companies in 1993 show that there are large variations in the results of different projects. This is a result of the method of internal assessment where project personnel assess the quality of their own performance. The results of examples A and C are quite different and are yet projects of same company. The large differences between the results of various projects are assumably a consequence of the differences in quality consciousness and criticalness of various projects. When several assessments of a project are combined into the company's overall results, the differences between various main criteria become less distinct. This is shown by company-level examples D and E, *fig. 17*.

RESULTS OF INTERNAL ASSESSMENTS

TQM - The Nordic Way



Assessment result
 Maximum points
 Result per cent of max

Fig. 17 Results of internal assessments of TQMNW companies in 1993

On the site level, the project manager runs his own projects quite independently. He builds up his know-how over time, primarily through experiences gained from own projects. Transfer of experiences within a company from one project to another could be more wide-ranging than presently and highly beneficial to the company. Internal assessment offers the opportunity of discovering the good procedures used in various sites. It is beneficial to the project manager to learn which other sites have improved their results in some sub-area, so that he can ask about the procedure used there.

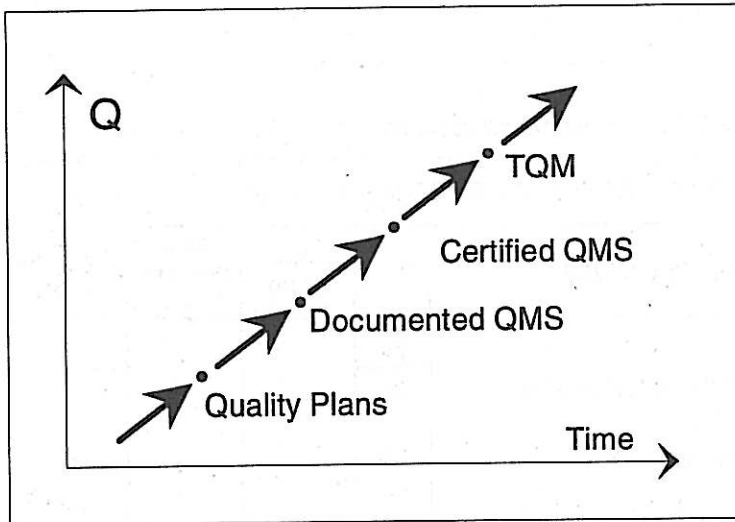
The earned score can be made use of in the planning of development measures by adding a column to the assessment form where a goal for next year's result is provided. The addition of another column for estimated costs resulting from measures intended to implement the new goal allows prioritizing development measures on the basis of their profitability, *table 7*.

Table 7 Earned score, new goal and estimated costs of achieving it

ANALYSIS OF ASSESSMENT AND PRIORISATION OF FURTHER ACTIONS					
Malcolm Baldrige	TQM The Nordic Way	Max	Earned score	New possible goal	Estimated costs
1 Leadership	1 Leadership	90			
	a. disseminates TQM philosophy by example	20			
	b. creates, updates and sets clear quality goals	20			
	c. directs quality work aimed at better customer satisfaction	25			
	d. exhorts employees into development cooperation	25			
2 Information and Analysis	2 Information and Analysis	80			
	a. external information on delivery	15			
	b. internal information on quality and development ideals is collected	15			
	c. quality is equated with	10			
	d. internal information is analyzed and disseminated				
e. development ideas are processed further	25				
3 Strategic Quality planning	3 Strategic Quality planning	60			
	a. operational modes; routines are based on facts/analyses	10			
	b. quality policy; developed, broken in and operating/understood	15			
	c. quality programme for short and long term	15			
	d. continuous monitoring and updating of planning	10			
e. strategy adapted to economic and local conditions	10				

6.6 Conclusions based on measurements

Measurements based on quality awards are a quite sophisticated and demanding way of assessing a company's performance quality level. It requires strong company management that is not afraid to subject itself and its management methods to organizational assessment. On the other hand, there are many basic factors related to quality development that need to be put right before the members of an organization can accept the idea of continuous quality improvement. For this reason, it may be difficult to introduce the method in a company whose quality development is still in its infancy *fig. 18*.



*Fig. 18. Intermediate goals of quality development.
A written and implemented quality system forms
a good basis for internal assessments.*

Internal assessment based on the sets of questions associated with quality awards is, however, an indicator beneficial also to construction companies. It has features similar to those of internal audits, but it is more comprehensive as an indicator. On the other hand, the result is less accurate than the assessment of an independent auditor. The greatest value of internal assessment is not, after all, the absolute score awarded, but the discussion aroused by the assessment process itself.

7. Vocabulary

Improvement	increasing the value, attractiveness
Measure	to determine a quantity
Result	outcome of an activity
Improve	increase the value, attractiveness or benefits of an entity
Entity	product, service, process, organization or person
Vision	foresight, thoughts, wishes on future development
Policy	formally intentions, course, guidelines, plan of actions
Objective	the object of one's endeavours, goal, aim
Goal	the aim or object towards which an endeavour is directed
Target	a fixed goal or objective
Feedback	retrieval of the output result for comparison with the target
Objective	the object of one's endeavours, goal, aim
Standard	example that one can measure against
Nonconformity	nonfulfilment of specified requirements
Deviation	the difference between an observed value from some accepted reference value
Waste	rejected, unused or not used to full advantage
Benchmarking	comparisons with competitors, or with "best practice" for improvements
Efficiency	functioning or producing effectively and with the least waste of effort
Quality programme	a set of activities, resources and events serving to implement the quality system of an organization

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Total Quality Management – TQM – as defined in the vocabulary ISO/DIS 8402:1991

- 1) *A management approach of an organization,*
- 2) *centered on quality, based on the participation of all its members*
- 3) *and aiming at long term success through customer satisfaction and benefits to the members of the organization and to society.*

TQM The Nordic Way, interpretation for a contractor

- 1) *A management approach of an organization,*
 All managers at all levels shall succeed in stimulating their employees to continuous improvements, since they encourage all their employees to participate and co-operate. The managers commit themselves, through their leadership of the improvement work, and through their personal behaviour.
 The strategic management of the company is flexible, and can tackle sudden changes such as conjunctures, alterations in market and local conditions, and can if necessary, adapt their business philosophies, politics and goals to meet such changes.
- 2) *centered on quality, based on the participation of all its members*
 Our guiding principle is that the right quality is to be achieved by preventive action. Supervision, and following up of deviations are aids to improvements. All employees are to recognise their responsibility, know what is expected of them, and be able to inspect and improve their own efforts.
 All employees know who their "internal" customers are, and compare their own production with the needs and demands of these in the same way as they do with external customers.
 The company regards its suppliers as fellow contributors to the building process. In a project context, efforts are made to stimulate improvements as much for the whole as for each of the parties. In addition to evaluating and selecting partners in the process of supply development, the company must also assess how satisfied the suppliers are with the company as task commissioner.
 All employees have understood how they can contribute to the improvements, and keep an observant eye on the quality of their products or services, activities and goals. This applies to both the company as a whole, and to the management of projects and work on the individual building sites.
 The company encourages employees to come forward with their ideas of what should be improved and how. The company actively pursues such suggestions, and follows them up with priorities and execution. Improvement measures are worked into an annual programme of action. As many measures as possible should have goals that can be measured.
- 3) *and aiming at long term success through customer satisfaction and benefits to the members of the organization*
 The company's most important standard of comparison is the satisfaction of its customers, both commissioners and end users. Therefore our company and all our employees are always aware of the customer: who he is, and what are his requirements and expectations. The goal is that we should fulfil these expectations 100%, and this is checked both during and after the process.
 Total Quality Management shall reduce the costs and we should be able to document short term improvements and better long term profitability.
 The company regards its employees' health, safety and work environment as an integrated part of the quality concept. Furthermore, the company ensures continuous development of the competence (read: "quality") of its workers through training and information. The company follows up its employees via the management at all levels. Health, work environment and safety are continuously monitored, and improvement measures are incorporated in the company's total plan of action.
 The company shall comply with the demands and duties required by society, with particular diligence in relation to environmental considerations.

A contractors internal assessment of the company as a whole

Unit:

Annual budget:

No. of employees:

Date:

Signature:

Malcolm Baldrige	TQM The Nordic Way	Internal assessment							
		Max	Max	1: 0%	2: 15%	3: 50%	4: 75%	5: 75%	Result
1. Leadership	1 Leadership	90							
	a. disseminates TQM philosophy by example	20							
	b. creates, updates and sets clear quality goals	20							
	c. directs quality work aimed at better customer satisfaction	25							
	d. exhorts employees into development cooperation	25							
Sum 90									
2. Information and Analysis	2 Information - Analysis -Reporting	80							
	a. external information on delivery quality is collected	15							
	b. internal information on quality and development ideas is	15							
	c. quality is equated with competitiveness	10							
	d. internal information is analyzed and disseminated	15							
	e. development ideas are processed further	25							
Sum 80									
3. Strategic Quality Planning	3 Strategic Quality Planning	60							
	a. operational modes: routines are based on facts/analyses	10							
	b. quality policy: developed, broken in and operating/understood	15							
	c. quality programme for short and long term	15							
	d. continuous monitoring and updating of planning	10							
	e. strategy adapted to economic and local conditions	10							
Sum 90									
4. Human Resource Development and Management	4 Personnel and Cooperation	150							
	a. personnel development: goal/programme and results	25							
	b. work of development groups and their heads	25							
	c. contribution of personnel: sense of responsibility	20							
	d. personnel's commitment to quality	20							
	e. awareness about quality focus	20							
	f. personnel's comfort, environment, goal/results/data	40							
Sum 150									
5. Management of Process Quality	5 Management of Process Quality	140							
	a. quality control of methods: quality improvement	25							
	b. market monitoring and sales	15							
	c. development and planning	15							
	d. production	25							
	e. procurement and suppliers of products and services	15							
	f. other cooperating partners	10							
	g. internal control activities	15							
	h. consideration of environment, societal	20							
Sum 140									
6. Quality and Operational Results	6 Operational result	180							
	a. products and services: achieved improvements	40							
	b. main processes (5b, 5c and 5d): improvements	40							
	c. suppliers and cooperating partners	20							
	d. control activities	25							
	e. environmental and societal impacts	25							
	f. goal/result of organization (economic and other)	30							
Sum 180									
7. Customer Focus and Satisfaction	7 Customer satisfaction	300							
	a. awareness of customers demands and expectations	100							
	b. permanent improvements in quality received by customer	25							
	c. attainment of customer satisfaction (methods, results)	100							
	d. quality is equated competitiveness	25							
	e. future customer demands and adaptation of organization	50							
Sum 300									
Total 1000	Total, 1 - 7	1000							

Self-assessment classes:

- 1: 0% No specific mode of operation or method has been selected.
- 2: 25% Mode of operation exists, but is not fully systematic and only in limited use.
- 3: 50% Systematic mode of operation exists and is widely used.
- 4: 75% Wide-spread modes of operation have yielded good results in many areas
- 5: 100% First rate results have been received as a result of modes of operation that have spread company-wide.

A contractors internal assessment of a construction project

Unit:

Project:

Budget:

Proc. method:

Implemented:

Own employees:

Date:

Signature:

Malcolm Baldrige	TQM The Nordic Way	Internal assessment							Result
		Max	Max	1: 0%	2: 15%	3: 50%	4: 75%	5: 75%	
1. Leadership	1 Management	90							
	a. derives project goals from company goals and sticks to them	20							
	b. is customer oriented and promotes implementation of demands	20							
	c. directs quality work and exhorts groups to development work	25							
	d. exhorts suppliers to engage in joint development	25							
Sum 90									
2. Information and Analysis	2 Information - Reporting	80							
	a. data/experiences from completed projects analyzed	15							
	b. control system to enable learning from project mistakes	15							
	c. contacts with customer, use and markets	10							
	d. contacts with suppliers and cooperating partners	15							
Sum 80	e. contacts with company management	25							
3. Strategic Quality Planning	3 Quality Planning - Systematics	60							
	a. quality planning and policy	10							
	b. adherence to quality plan and its updating	15							
	c. quality improvement programme	15							
	d. time schedules and project budget	10							
Sum 90	e. quality reports	10							
4. Human Resource Development and Management	4 Personnel - Cooperation	150							
	a. personnel and group development	30							
	b. commitment, attitude towards quality	25							
	c. development of suppliers and cooperating partners	25							
	d. ideating atmosphere, suggestions for improvements and	35							
Sum 150	e. personnel comfort, environment, goal/results/knowledge	35							
5. Management of Process Quality	5 Quality, health, environment and safety	140							
	a. quality control of project need survey	10							
	b. quality control of project planning	15							
	c. planning quality control	20							
	d. production quality control	20							
	e. quality control of handover services	10							
	f. quality control of procurements and suppliers	15							
	g. quality control of time-use and economy	25							
Sum 140	h. environmental friendliness, societal responsibility/requirements	25							
6. Quality and Operational Results	6 Project result	180							
	a. project plan	10							
	b. detail drawings, operating instructions	20							
	c. product (building, dwelling), quality, documentation	35							
	d. processes, achieved improvements	25							
	e. time and economy	25							
	f. goal/result of organization (economic and other)	25							
	g. environmental and societal impact	25							
Sum 180	h. feedback, plan for utilizing feedback	15							
7. Customer Focus and Satisfaction	7 Customer satisfaction (internal and external)	300							
	a. knowledge of customer's (user's) demands and expectations	50							
	b. permanent improvements in quality received by customer	25							
	c. customer feedback during work	50							
	d. processing of notices of defects and repairs	25							
	e. attainment of customer satisfaction (methods, results)	75							
	f. comparison with customer satisfaction in other projects	25							
Sum 300	g. feedback from authorities	50							
Total 1000	Total, 1 - 7	1000							

Self-assessment classes:

1: 0%

No specific mode of operation or method has been selected.

2: 25%

Mode of operation exists, but is not fully systematic and only in limited use.

3: 50%

Systematic mode of operation exists and is widely used.

4: 75%

Wide-spread modes of operation have yielded good results in many areas

5: 100%

First rate results have been received as a result of modes of operation that have spread company-wide.

APPENDIX 4

A contractors internal assessment of a site

Unit:
Budget:
Own employees:

Project:
Proc. method: Implemented:
Date: Signature:

Malcolm Baldrige	TQM The Nordic Way	Internal assessment							
		Max	Max	1: 0%	2: 15%	3: 50%	4: 75%	5: 75%	Result
1. Leadership	1 Management	90							
	a. derives site goals from company goals and sticks to them	20							
	b. is customer oriented and promotes implementation of demands	20							
	c. directs quality work and exhorts groups to development work	25							
	d. exhorts suppliers to engage in joint development	25							
Sum 90									
2. Information and Analysis	2 Information - Reporting	80							
	a. data/experiences from completed projects are analyzed	15							
	b. control system to enable learning from project mistakes	15							
	c. contacts with customer, user and markets	25							
	d. contacts with suppliers and cooperating partners	15							
	e. contacts with company management	10							
Sum 80									
3. Strategic Quality Planning	3 Quality Planning - Systematics	60							
	a. quality policy and plan as well as quality assurance plan	10							
	b. adherence to quality plan and its updating	15							
	c. quality improvement programme	15							
	d. time schedules and project budget	10							
	e. quality reports	10							
Sum 90									
4. Human Resource Development and Management	4 Personnel - Cooperation	150							
	a. personnel and group development	30							
	b. commitment, attitude towards quality	25							
	c. development of suppliers and cooperating partners	25							
	d. ideating atmosphere, suggestions for improvements and	35							
	e. personnel comfort, environment, goal/results/knowledge	35							
Sum 150									
5. Management of Process Quality	5 Quality, health, environment and safety	140							
	a. HES quality control (responsibility, org., instr., equip.)	10							
	b. HES quality assurance (occup. safety, inspections)	15							
	c. HES development programme/measures	20							
	d. production quality control (own and subcontractors')	20							
	e. quality control of handover and utilization of feedback	10							
	f. quality control of procurements (requirements, acceptance	15							
	g. quality control of time-use and economy	25							
	h. environmental friendliness, societal responsibility/requirements	25							
	Sum 140								
6. Quality and Operational Results	6 Site result	180							
	a. health, environment and safety (incl. absences)	25							
	b. detail drawings, operating instructions	20							
	c. product (building, dwelling), quality, documentation	40							
	d. processes, achieved improvements	20							
	e. time and economy	20							
	f. goal/result of organization (economic and other)	20							
	g. environmental and societal impact	20							
	h. feedback, plan for utilizing feedback	15							
Sum 180									
7. Customer Focus and Satisfaction	7 Customer satisfaction (internal and external)	300							
	a. awareness of customer's (user's) demands and expectations	50							
	b. permanent improvements in quality received by customer	25							
	c. customer feedback during work/handover	50							
	d. processing of notices of defects and repairs	25							
	e. attainment of customer satisfaction (methods, results)	75							
	f. comparison with customer satisfaction in other projects	25							
	g. feedback from authorities	50							
Sum 300									
Total 1000	Total, 1 - 7	1000							

Self-assessment classes:

- 1: 0% No specific mode of operation or method has been selected.
- 2: 25% Mode of operation exists, but is not fully systematic and only in limited use.
- 3: 50% Systematic mode of operation exists and is widely used.
- 4: 75% Wide-spread modes of operation have yielded good results in many areas
- 5: 100% First rate results have been received as a result of modes of operation that have spread company-wide.

