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QUALITY MANAGEMENT IN UPHEAVAL

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Abstract

The situation is presently moving towards "elbow competition", where manufacturers are fighting for a place to stand in the market.

Quality Management has come to a significant conclusion: The customer basically has a free choice in the respective price-range, therefore choosing not only the good, but obviously selecting the better product, the product fulfiling the continuously rising expectations to the greatest extent.

But the methods of Quality Management, till now, were being perfected to freeze empirically established specification limits, which had been judged to be sufficient at one time. Corrective actions were initiated only when specification limits were exceeded. Even with extensive effort this type of static Quality Management will result in a loss of competitiveness in the prevailing markets.

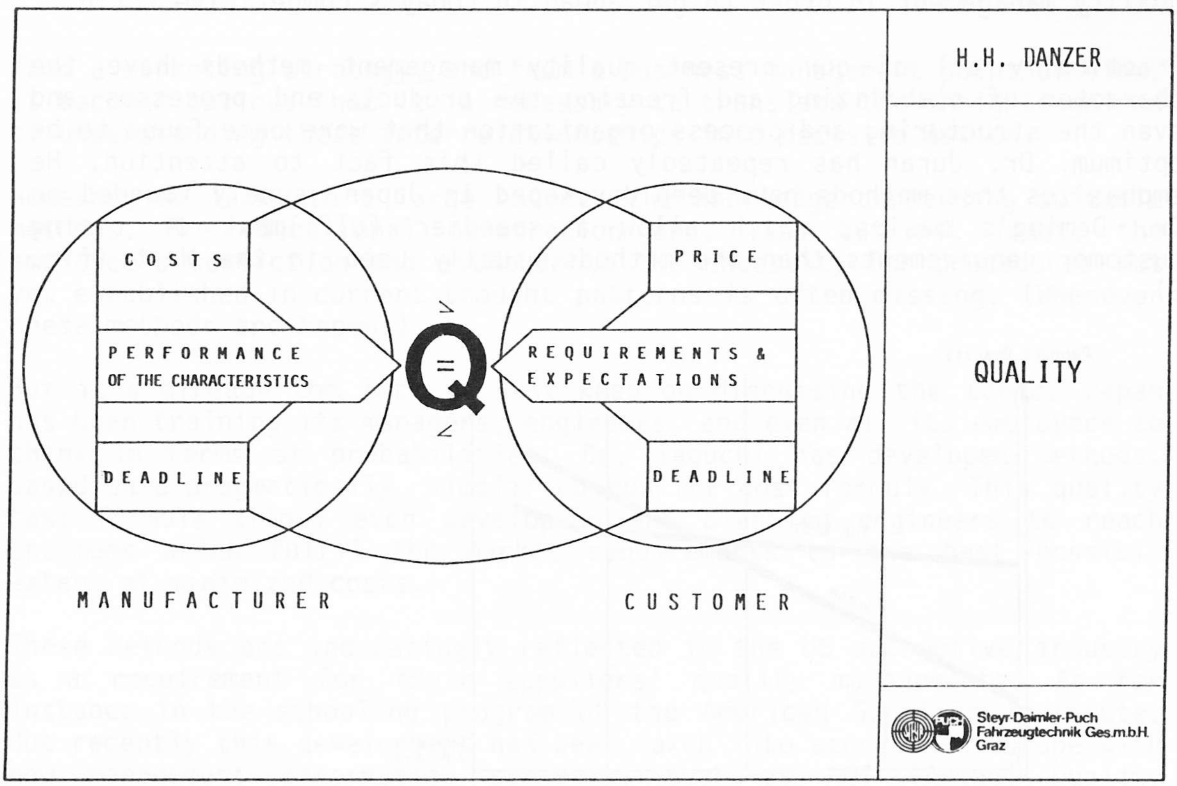
In order to prevent this we need to expedite the re-thinking of our quality models and hasten the use of new methods suited to the dynamic customer behaviour of today. This can avert the danger, that all other efforts - such as technological innovation and progress, flexible automation, and extreme rationalizing - will be spent in vain.

QUALITY MANAGEMENT IN UPHEAVAL

Introduction

For centuries, we in Europe have had a tradition of quality craftsmanship and have always been proud of the quality standards our products have met. Our schooling programs, for statistical quality control, go far beyond normal school knowledge. And then, right in the middle of our perfectly automated test procedures, comes a report, stating that we are lagging hopelessly behind with our methods of quality management. Is it possible that the products, optimized by our technicians, engineers, technologists, and manufacturing engineers, are no longer what the customers dream of?

The answer is very sobering.
Customers don't buy developmental and production technological optimization, only the best possible fulfilment of the requirements and justified expectations in the respective price segments make products attractive to the customer (fig. 1).



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Dr. H.H. Danzer

Market behaviour

In the era of the congested "elbow market", the customer represents the sole standard setter. In other words, even the best in their respective classes are constantly being challenged by the customer and can't freeze their achieved standards, on the contrary, the customer wants to be continuously assured that the chosen brand still fulfils his or her demands and requirements to the best possible extent.

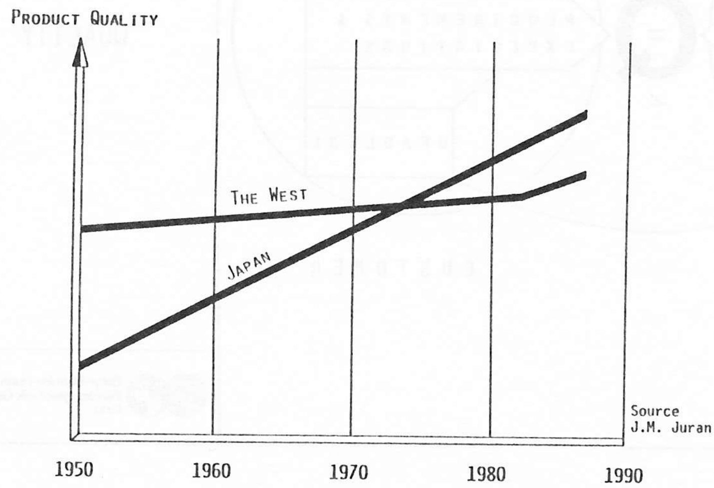
Whenever customer expectations aren't met, snowballing in sales drops result as a consequence of the excellent communication among customers.

Prof. Niefer reported a multiplication factor of 11 with dissatisfied customers , whereas satisfaction results in a factor of only 3, because one obviously tends to take an enthusiast less seriously than someone who's annoyed about a product.

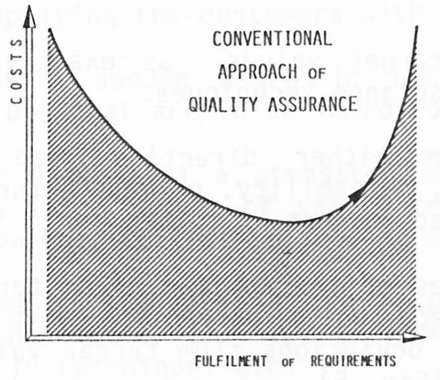
Consequences

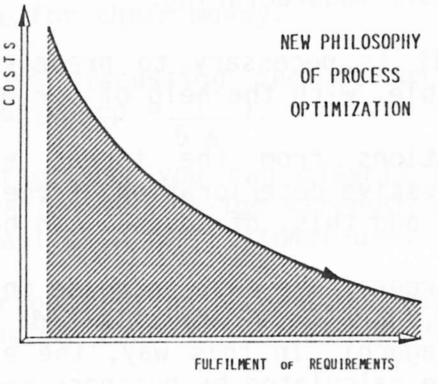
The conclusion derived from these marketing strategy connections is simple but serious:
We must come from a static quality management to a highly dynamic quality management in order to get ahead in today's competitive world.

Practically all of our present quality management methods have the character of stabilizing and freezing the products and processes and even the structuring and process organization that were once found to be optimum. Dr. Juran has repeatedly called this fact to attention. He emphasizes that methods have been developed in Japan, surely founded on Dr. Deming's basics, which allow a speedier fulfilment of rising customer requirements than the methods usually used in the West (fig. 2).



Just how deeply this thinking in terms of statistical optimization is rooted in us, is shown by the depiction for quality optimization, which can be found in every textbook, and in which defect prevention is generally interpreted as inspection effort and the production processes are regarded as given . Kirstein made it clear in 1987, that total costs develop completely differently if an optimization of processes instead of inspection is conducted. In the course of this, the seemingly paradoxical case occurs, where increasingly better fulfilment of the requirements, i.e. quality improvement, actually causes costs to drop consistantly (fig. 3, fig. 4).





From a marketing strategy, and from a business management point of view, it becomes obvious that it is necessary to translate the insights gained by understanding these interrelationsships into decisive action.

However, we lack, to a large extent, the knowledge concerning suitable methods. The educational penetration and, last but not least, the employee's conviction and attitude to the necessity for procedures not yet established in current thought patterns is often missing. (Whenever these methods are known.)

But it's already too late to just keep on discussing the topic. Japan has been training its managers, engineers, and even all its employees to think in terms of probabilities. Dr. Taguchi has developed methods, based on a pragmatically simplified quality cost formula. This quality cost formula allows even developing and planning engineers to reach optimums which fulfil the market requirements to the best possible extent at minimized costs.

These methods are increasingly reflected in the US automotive industry as a requirement for their suppliers' quality managements. As for instance in the schooling program of the American Supplier Institute. But recently this development has been taken into account in Europe with new management information seminars, such as AQI (Annual Quality Improvement), for example organized by the DGQ.

New philosophy

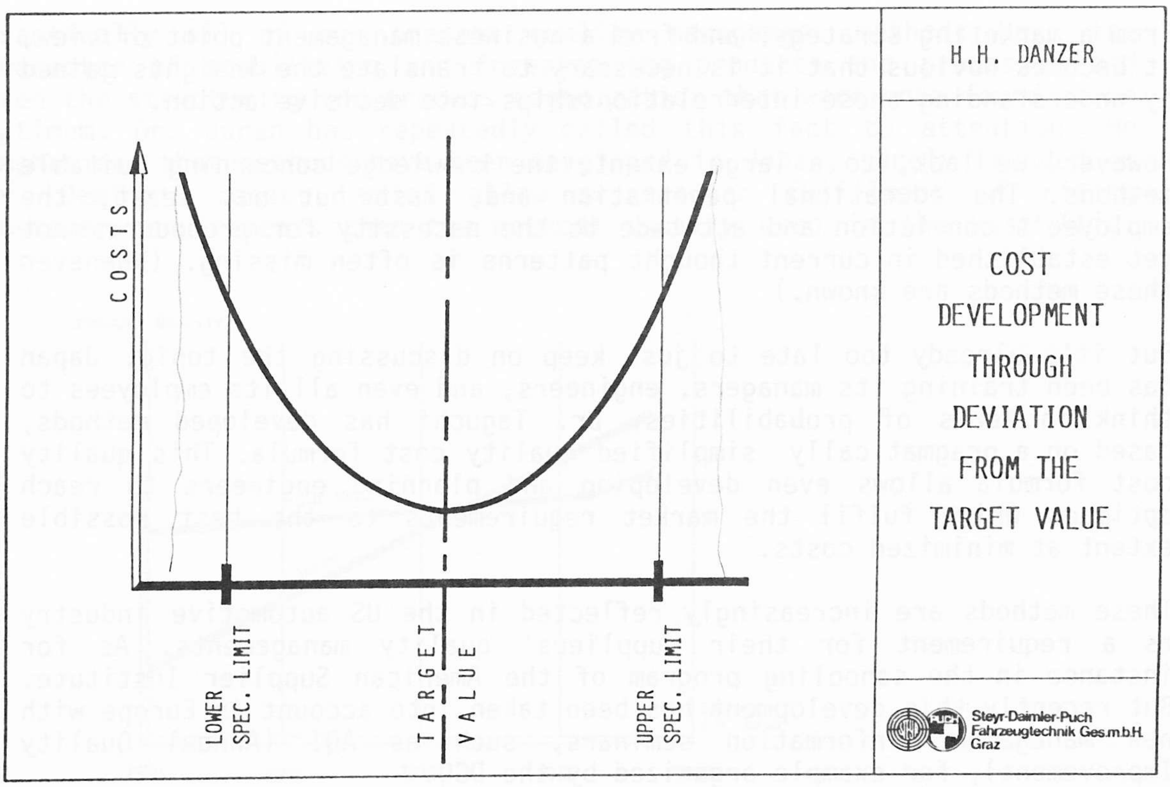
In the next few minutes I would like to make you acquainted with these thought patterns which are unfamiliar to most of us:

Forget everything you've heard so far about tolerances and the methods to meet them and imagine the following: Based on calculations and extensive tests, the Development Department, in cooperation with production technicians, has succeeded in finding, and laying down, those target values which fulfil the purpose to the best possible extent. The purpose being function and usefulness to the customer as well as feasible manufacturing.

Now it is necessary to preserve these target values as exactly as possible, with the help of our Quality Assurance techniques.

Deviations from the target values, in either direction lead to progressive deterioration of the function, reliability, or manufacturing ease, and this, of course, can be expressed in cost.

The progressive cost increase on both sides of the optimum, i.e. target value, has been approximated, simplified, as a parabolic curve by Dr. Taguchi. In this way, the effects of deviations from target values can be calculated by business management (fig. 5).



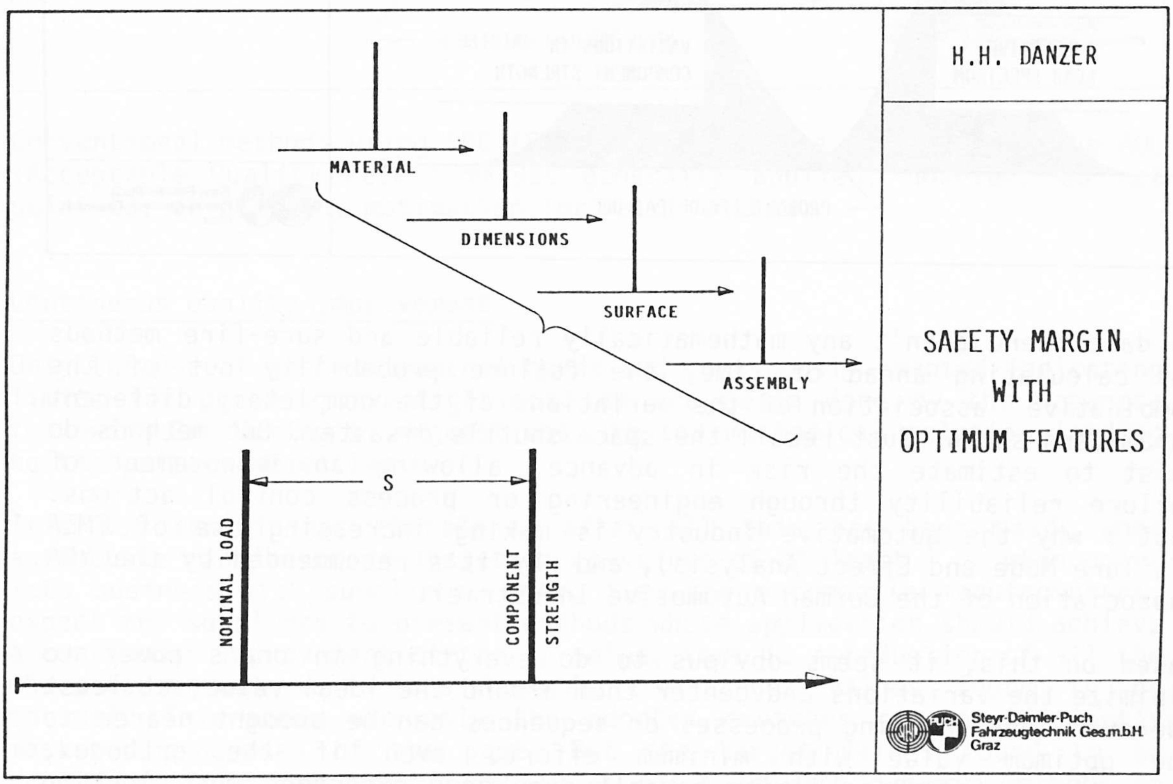
Let's assume that Development, together with Production Engineering would actually in the position to lay down target values for the individual characteristics corresponding to an optimum value-for-money ratio. Imagine that we also had an instrument, to evaluate the effect of every deviation from these target values.

It's obvious that anyone in this position would try, in every possible way, to reduce the natural deviations from the target values. Yes, one would develop methods to systematically reduce the variations previously regarded to be God-given, and to concentrate and center said variations around the target value, thereby keeping total cost as low as possible and supplying the customers with more value for their money.

All of a sudden we're in the middle of discussing the so-called cp-values that are to be improved continuously ($cp = \frac{T}{6\,s}$).

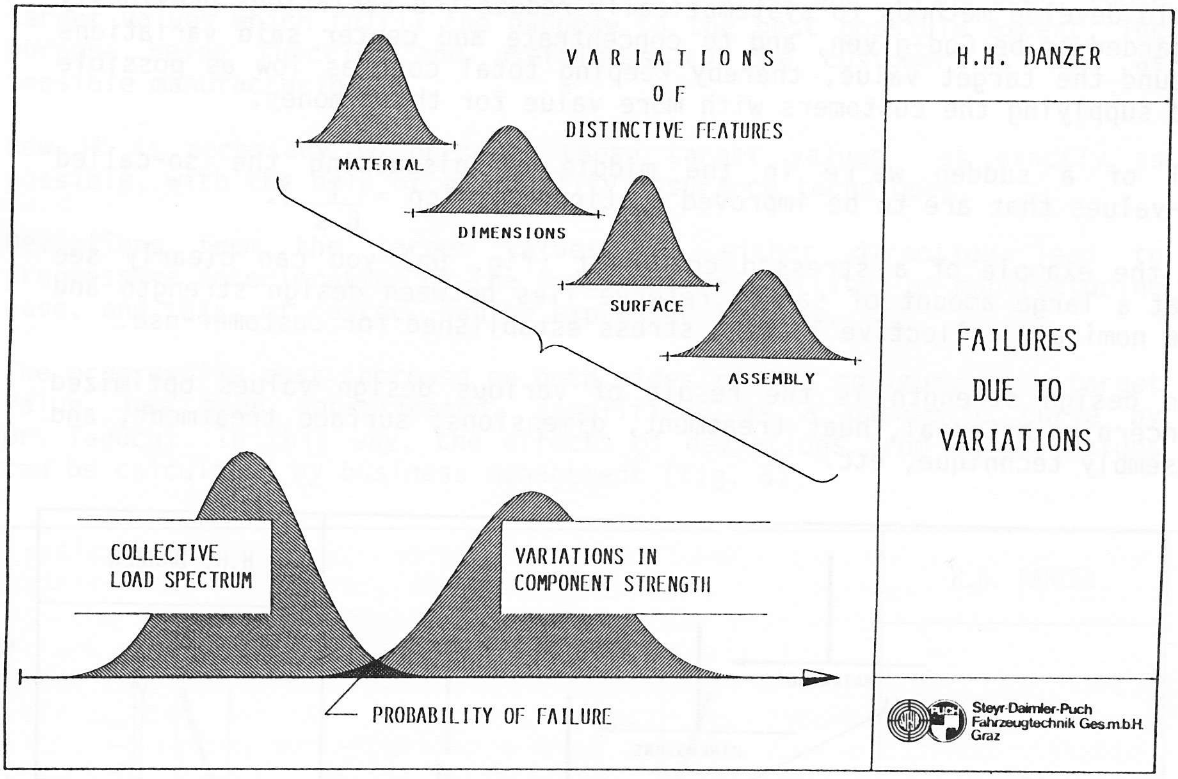
In the example of a stressed component (fig. 6a) you can clearly see what a large amount of safety reserve lies between design strength and the nominal, collective loading stress established for customer-use.

The design strength is the result of various design values optimized concerning material, heat treatment, dimensions, surface treatment, and assembly technique, etc.



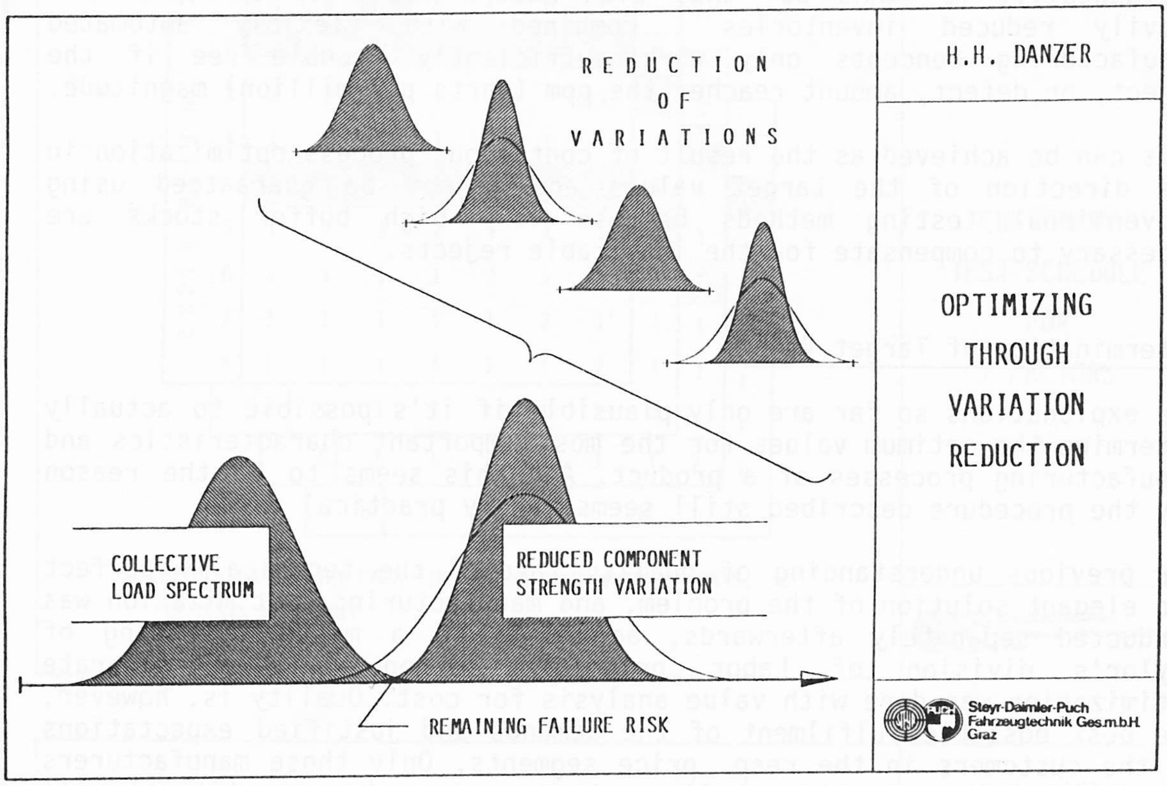
Effect of spreads

Unfortunately, the technically unavoidable spread of the characteristics involved lead to an overlap of the probabilities of actual strength and actual stress loading. You have encountered this overlap in the form of guarantee and fair-dealing costs, in sales reductions due to unsatisfied customers, and sometimes cases in product liability (fig. 6b).



To date there aren't any mathematically reliable and sure-fire methods for calculating ahead of time, the failure probability out of the combinative association of the variations of the completely different parameters shown. Just recall the space shuttle disaster. But methods do exist to estimate the risk in advance, allowing an improvement of failure reliability through engineering or process control actions. That's why the automotive industry is making increasing use of FMEA (Failure Mode and Effect Analysis), and why it's recommended by the VDA (association of the German Automotive Industrie).

Based on this, it seems obvious to do everything in one's power to minimize the variations and center them around the ideal value, at least wherever manufacturing processes or sequences can be brought nearer to the optimum value with minimum effort, even if the orthodox, conventional tolerance limits haven't even been exceeded. Just looking at the combined probabilities of the characteristics involved with function or cost and the resulting reduction of the remaining risk caused by the actions taken as seen in the development of the second curve shown in figure 6c, indicates the profitability of these activities.



Conventional methods using SPC (Statistical Process Control) and the AQL (Acceptable Quality Level) values generally applied, however, do not point to, or give any motivation for, such action.

Continuous Quality Improvement

Only the use of process control cards and continously adapted indicating limits for process investigations, as are being done by the Japanese following Dr. Deming's suggestions, is the methodical solution leading to the primary objective.

It's not surprising, therefore, after all this has been said, when automobile manufacturers insist on cp-values of at least 1,33 when going into business with suppliers. They, i.e. the automobile manufacturers, expect the suppliers to present methods whose application should achieve a continuous improvement of the cp-value, that is a reduction of all the characteristics' variations towards the target values found to be optimal. Tolerances are only the adopted crutches of insufficiently mastered processes of the past. But the target values found to be optimal must be reached as exactly as possible with dynamic methods to insure a successful attractiveness on the market.

Logistics

Incidentally, it turns out that even modern logistics concepts with heavily reduced inventories combined with flexibly automated manufacturing concepts only work sufficiently trouble-free if the reject, or defect, amount reaches the ppm (parts per million) magnitude.

This can be achieved as the result of continuous process optimization in the direction of the target values and cannot be guaranteed using conventional testing methods because very high buffer stocks are necessary to compensate for the inevitable rejects.

Determination of Target Values

The explanations so far are only plausible if it's possible to actually determine the optimum values for the most important characteristics and manufacturing processes of a product. And this seems to be the reason why the procedure described still seems barely practical to us.

Our previous understanding of quality favored the technically perfect and elegant solution of the problem, and manufacturing optimization was conducted separately afterwards, according to a misunderstanding of Taylor's division of Labor principle. Often, another separate optimization was done with value analysis for cost. Quality is, however, the best possible fulfilment of the demands and justified expectations of the customers in the resp. price segments. Only those manufacturers (who can stand up to this challenge better than the competitors) will survive in the congested "elbow market" and have the chance to expand.

Ladies and Gentlemen, effective methods do exist, which help to find overall optimizations and allow their further adaptation to a dynamic market.

It was the Japanese again, who turned the well-known optimizing methods into a fairly simple form that can be applied at a reasonable cost. In the generally used "One Factor by One"-Method one changes an examined parameter that is being looked at, and registers the effect to aid design and process optimizing. Take, for example, 7 different influential factors and therefore, one basis test and 8 variation tests are necessary, and one can calculate the effect of individual parameters by comparing the respective test with the basis test.

This works, of course, only when assuming that the other parameters can actually be kept constant. As a rule, though, this is generally not true, so we are forced to repeat the test sequence 3 times to achieve a more representative result (fig. 7).

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CUSTOMARY TEST SCHEDULE FOR 7 FACTORS

INFLUENTIAL FACTORS

EXPERIMENT NO.	A	B	C	D	E	F	G
1	1	1	1	1	1	1	1
2	2	1	1	1	1	1	1
3	1	2	1	1	1	1	1
4	1	1	2	1	1	1	1
5	1	1	1	2	1	1	1
6	1	1	1	1	2	1	1
7	1	1	1	1	1	2	1
8	1	1	1	1	1	1	2

8	1	1	1	1	1	1	2
8	1	1	1	1	1	1	2
8	1	1	1	1	1	1	2

EFFECT CALCULATED EACH TIME OUT OF 2 INDIVIDUAL TESTS.
32 TESTS NECESSARY.

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TEST SCHEDULE WITH ORTHOGONAL TABLES (7 FACTORS)

INFLUENTIAL FACTORS

EXPERIMENT NO.	A	B	C	D	E	F	G
1	1	1	1	1	1	1	1
2	1	1	1	2	2	2	2
3	1	2	2	1	1	2	2
4	1	2	2	2	2	1	1
5	2	1	2	1	2	1	2
6	2	1	2	2	1	2	1
7	2	2	1	1	2	2	1
8	2	2	1	2	1	1	2

EFFECT CALCULATED EACH TIME USING WHOLE TABLE.
WITH AVERAGED VALUES ONLY 8 EXPERIMENTS NECESSARY.

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Dr. Taguchi recommends reviving the well-proven orthogonal table techniques to economically solve the resulting problem of statement validity and explosive increase in necessary tests. These techniques suggest arranging the test combinations so that in one group of 8 tests the character variations are combined in such a way that each parameter shows up 4 times in level 1 and 4 times in level 2 respectively, but each time in a different configuration. Then during evaluation, an average out of 4 values of a parameter setting affect the result for each case. The effect of every parameter is calculated using the whole test group and not out of only one line, as is the case with the conventional "One Factor by One"-Method (fig. 8).

Using this method reduces the necessary number of optimizing tests for the before-mentioned example to only 25 % with an equal reliability for the resulting statements.

This often only makes it possible to conduct optimizing tests during development and process planning in a consistent and economic manner. Only by using such simply executed methods yet based on an ingenious background, will it be possible to find target values satisfying the customer better and better in all enterprising functions in the future.

Conclusions

We are forced, ladies and gentlemen, by the enormous competitive pressure of today's economic market to integrate a new type of quality management into company policy, a quality management that doesn't merely satisfy itself with assuring and documenting production in terms of target values once found to be good, but a management that takes up the challenge of the market by insuring constant improvements.

We must be prepared to adapt even our form of organization and the way we manage things, from marketing and acquisition all the way to service and waste management.

We must develop our Quality Management dynamically to the best possible extent, to satisfy the constantly changing customer expectations, and we're obliged to find adequate methods and techniques to apply them. A customer satisfied with your product will reward you with sales figures insuring lasting commercial success.

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