Experiences of software quality management in software maintenance - a case study

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This case study shows how GAK in Amsterdam used a Quality Improvement Programme can be used as the driving force for process improvement, customer service enhancement and higher levels of productivity.

1. Introduction to GAK Dutch Social Security System

GAK means the joint Office for Social Security Administration. GAK has its headquarters in Amsterdam, Holland.

GAK is not a government department. It is managed by a superboard comprising: senior representatives from industry sectors including banking, engineering, insurance etc; labour unions; pension fund managers; common medical services.

The mission of GAK is to maintain and produce information systems that enable collection of contributions and payment of benefits according to Dutch law.

GAK is divided into three main components:

Annual revenues

**Federation of Occupation Associations** £ 12 billion

- unemployment benefits
- sickness benefits
- disability benefits

**Community Health Care** £ 9 billion

**Social Insurance Bank** £ 13 billion

- old age pensions
- widows / dependents pensions
- family allowance

**Total** £ 34 billion
Holland has a Federation of Occupational Associations. Within the Federation, some industries have joint administrations and some are independent.

Joint Administration, which GAK services, comprises the following industries:

- Dairy
- Timber / furniture
- Printing trade
- Metallurgical
- Electronics
- Docks
- Mercantile marine
- Transport
- Hotel and catering
- Public services
- Banks and insurances
- General industries
- New industries

In total, GAK services 65% of the working population of Holland at a cost of 8.7% of the premium receipts.

The industries that have independent administration are:

- Farmers
- Building Constructors
- Tobacco
- Bakers
- Butchers
- Retail trade
- Social / health care workers

These make up 35% of the working population at a cost of 8.8% of the premium receipts.

**GAK provides administration services for**

- 13 Occupational organisations
- 21 Pension funds
- Joint Medical Services
- 38 Early retirement organisations
- Health care for sailors

**The geographical distribution covers:**

- more than 100 locations
- Head office in Amsterdam
- 31 districts
• more than 50 regional offices
• many consulting offices for doctors (GPs)

The number of locations is still increasing.

Scale of GAK organisation

31 districts offices 11,000 employees
39 head office departments 4,000 employees
IT organisation 475 employees
Working in the IT field 750 employees

2. GAK Information Architecture and IT Organisation

GAK has been responsible for insurance administration since 1952. This is fundamentally about relating premiums with benefits.

Recently, a major change in the way this work is managed has been a shift from case oriented to person oriented.

As a consequence, GAK is establishing large databases for population, labour contracts and employers. Relationships between the various components of insurance administration can be shown as:

![Diagram showing relationships between People, Contracts, Employers, Benefits, and Premiums]
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**IT Organisation**

In general terms, the IT organisation (Automation) within GAK has three parts:

![Diagram of IT Organisation]

- Development (Ontw) - 120 people
- Maintenance (OIS) - 180 people
- Production (ATI) - 120 people

IT investments ~ £150 million

3. **How GAK started a Quality Initiative**

GAK was motivated to improve methods in order to gain more control over its operations. It also wanted to even out the large variation of procedures between applications and to enjoy higher levels of productivity and quality as perceived by customers.

The programme was structured into the normal strategic stages of determining:

- Where are we now?
- Where do we want to be?
- How can we get there?

GAK started a Quality Improvement Programme having successfully moved towards a planning culture but there were few valuable metrics, infrequent quality assurance and a large amount of variation across individual applications.

During the strategic planning stage, department objectives were identified and metrics derived for critical success factors. There was an initial focus on the areas of reliability and usability, which were critical at that time.
The behavioural changes in maintenance programmers, analysts and managers were brought about by a methodology named by GAK as Quintessence, which combined:

- Strategic planning (business-driven quantifiable objectives)
- Quality culture
- Metrics to change behaviour

It is important to realise that measurement is seen as an integral part of the GAK Quality Improvement Programme. The concept of a separate metrics initiative is not thought to be beneficial.

4. Quality and the maintenance process

GAK's Quality Improvement Programme is based on the principles of Crosby, Deming and Juran. Crosby's Four Absolutes of Quality Management are interpreted as follows:

1. Understanding the definition of quality (conformance to requirements)
2. Having a system for quality (looking at the process; prevention by reviews)
3. Setting a performance standard of quality (zero defects)
4. Using a measurement of quality which gets action (metrics)

These four Quality Absolutes are supported by 10 Quality Principles.

The GAK Maintenance Department is responsible for 78 major applications. There are five sectors, with three or four application managers responsible for between six to 10 analysts and programmers. Work in each application area is organised like this:
5. Changing attitude and culture

Not all staff were motivated by concepts alone to change their day-to-day practices. It was our experience that it is more effective to concentrate on the techniques, the concepts then fall into place. The vehicle used by GAK to change attitude and culture is a methodology called Quintessence.

In summary, the Quintessence methodology combines:

- Strategic planning
- Metrics to improve effectiveness
- Strategic use of quality management.

Quintessence has evolved into a TQM implementation methodology called Applied Process Improvement (API). API has five elements

- Management commitment
- Management of change
- Human resources: empowering people
- Business and automation processes
- Measurement and control

We broke the change process down into ten steps which form part of Quintessence and Applied Process Improvement.

Step One

A clear mission for the department was defined.

The mission was worded from a customer service point of view, and not restricted by reference to the current implementation.

Step Two

A Quality Metrics Council was instigated.

The Quality Metrics Council (QMC) comprised four managers and two people from a newly-formed metrics support group. The Quality Metrics Charter identified key quality metrics which provided a foundation for process improvement, and promoted their use by example, training and selling. Their responsibilities were:
The Quality Metrics Council

Step Three

*From the business mission, the Quality Metrics Council developed a number of quantifiable business objectives.*

To avoid ambiguity, each objective was clearly measurable and was associated with a practical acceptance test.

Step Four

*The Quality Metrics Council then decided which objectives were critical success factors (CSF).*

The Quality Metrics Council also carried out gap analysis on each critical success factor. They identified where the organisation was performing well on a csf and where it was not. Those csfs with the largest gap between required and actual performance were identified for immediate improvement.

A few simple metrics were selected that were considered to have high strategic leverage and that also represented a considerable gap between the current level of quality and the level required to fully conform to requirements.
Step Five

A metrics support group was set up.

The metrics support group were responsible for:

- Collecting data for each metric
- Maintaining and reporting from a metrics database
- Maintaining a quality file for use by the whole department.

Step Six

A group was set up to undertake cause and effect analysis for each metric.

A metrics template on a sheet of A4 paper was used for each metric. This contained the original objective and information about the gap between current performance and the target level. The purpose of cause and effect analysis was to examine the inter-relationship of problems and to produce a list of candidate solutions for consideration by the Quality Metrics Council. The Ishikawa Diagram was used in brainstorming sessions to undertake cause and effect analysis and a candidate solution form was used to collect proposed changes.

Step Seven

A Bill of Rights was drawn up to encourage both top down and bottom up communication to evolve effective changes. This gave all staff the right:

- To know precisely what is expected of them
- To clarify things with colleagues anywhere in the organisation
- To initiate clearer definitions of objectives and strategies
- To get objectives presented in measurable, quantified formats
- To change their objectives with their manager for better performance towards corporate goals
- To try new ideas for improving communication
- To challenge constructively higher level objectives and strategy
- To ensure that objectives are in line with reality.

The Bill of Rights was taken from Principles of Software Engineering Management by Tom Gilb.
Later in the programme, we introduced a pact between managers and their staff to agree:

- People *would not* be judged by the number of defects found during reviews / inspections
- People *would* be judged on the errors passed on downstream.

**Step Eight**

*An Impact Estimation Grid was used by the Quality Metrics Council to evaluate candidate solutions against key objectives.*

For ease of administration, the objectives and metrics were categorised into the following groups, commonly known as FURPS. The five groups were:

- Functionality
- Usability
- Reliability
- Performance
- Supportability

**Step Nine**

*Rigorous inspection techniques were introduced to ensure conformance to requirements.*

Inspection champions were selected for special training to pilot more rigorous inspections which included:

- Inspection checklists
- Clearly defined baselines
- Quality performance standards
- Defect lists.

**Step Ten**

*Results from the inspections were fed into the prevention cycle.*

It was stressed that inspections are of secondary importance to preventing the error in the first place. The prevention cycle comprises the following main stages:

- Collection of data (metrics database, defect lists)
- Cause and effect analysis
638 Software Quality Management

- Candidate solutions
- Impact analysis
- Plan of action to prevent errors

6. The Implementation of Changes

Education and training is seen as a vital element to the implementation of change in GAK. As new topics emerge such as ISO 9000 and important management decisions are made, changes are implemented through education and training and sustained through internal GAK facilitators.

**Education:**
- why quality is fundamental to success
- why ISO 9000?
- GAK Quality Management System

Education sessions are presented by members of the GAK Senior Management Team (Quality Metrics Council - now called the Quality Board).

**Training:**
- Lifecycle model - 'V' Model
- Reviews / inspections
- Requirements Definition
- Release Planning
- Configuration Management
- Service Level Agreements
- Quality Plans
- Documentation
- Testing
- Methodologies
- Change Control
- Quality Measurement (metrics)
  - product
  - process
  - service

GAK has its own training modules, typically two days duration, for each of the training topics. Procedure handbooks and facilitators are used to implement and support techniques and skills taught.

New employees attend all the education and training topics. Over a two year period approximately 180 people have been trained.

Reviews / inspections have been implemented across the whole organisation.
Release Management has been implemented. Requests for change are grouped into releases for each application system. The work contained in each release is calculated using Function Point Analysis and cost is estimated using various techniques including Constructive Cost Model (COCOMO). This is converted into work schedules with appropriate progress control mechanisms.

Another important vehicle for change was the implementation of the 'V' Model for all new releases and software enhancements.

**The GAK Software Maintenance 'V' Model**
An example of improvement in planning ability where P1 is time spent on interrupts to planned work ($t^2$).

What has changed?

- Reviews strongly related to the 'V' Model
- A more homogeneous department
- The use of metrics
  - P1 / P2
  - Complexity
  - Function Points
  - Jobs Failed

7. **ISO 9000 project**

GAK is aiming at certification by end 1993. To do this we have:

- Appointed a project leader (Future Quality Manager)
- Reporting to a Quality Board
- All sectors are committed to a 10% investment in quality (5% for the ISO 9000 project)

A number of principles have been applied to ISO 9000 project organisation:

- working groups for each vital ISO 9000 element
- involvement of all the OIS sectors
- early involvement of the organisation responsible for the certification (Institute for the Certification of Information Technology, ICIT)
8. Conclusions and Recommendations

We have reached a number of conclusions and recommendations from our experiences on the GAK Quality Improvement Programme. They are listed and summarised as follows:

Conclusions

1. We identified and quantified departmental goals which would solve known business weaknesses
2. We achieved rapid results from early use of selected metrics
3. We experienced cost migration problems. For example, percentage promises delivered increased because fewer promises were made
4. Initially, solutions were confused with objectives
5. A bottleneck in obtaining data for metrics was resolved by metrics staff collecting data directly
6. We soon realised we needed to improve the way we conducted our meetings
7. After six months our QIP took hold. Graphical cause and effect diagrams quickly spread, communication rapidly improved, confidence grew in professional methods
8. Vague baselines and standards were giving poor management control. These were redefined
9. We re-worked our inspection checklists and standards
10. We identified a need for better co-ordination with our Systems Development department. A less political way forward was evolved through the use of Systems Acceptance Standards, inspections and metrics.
11. We re-defined and extended the role of our Quality Support Group
12. The cost of spoilage was quantified using inspections and by recording time spent on rework
13. A Quality Plan was introduced for each project.

At the end of the first year of the programme, we carried out a detailed Quality Perception Acceptance questionnaire. Results varied across Sectors according to the attitudes and perceptions of the Sector Heads. Results of the questionnaire were used to shape the quality education, training and facilitator programmes.

**Recommendations**

From our experiences, we can make the following recommendations:

1. Attitude training is of vital importance (especially in the case of a relatively young staff)
2. Providing good service to customers is more and more required by users who are becoming more and more demanding
3. In the last decade we have paid too much attention to technical training and too little on quality training including team and communication skills. We now split our training budget two thirds technical training and one third quality training
4. On the quality road there is no way back
5. As always; strong IT management involvement is a prerequisite
6. Changing to a quality culture is a project
7. Strong project management is required
8. The quality initiative must have defined phases with timescales, objectives and deliverables
9. Champions and facilitators are key to sustaining a quality culture.

**Our keys to success**

Our quality initiative would have failed if we had not taken a co-ordinated approach involving the key elements:
Software Quality Management

- Management commitment
- Management of change
- Human resources: empowering people
- Business and automation processes
- Measurement and control

We recognised some possible threats to our quality initiative

- Loss of momentum
- Apathy
- 'Flavour of the Month' Syndrome
- Management backout

These were carefully managed to make sure they were avoided.

We found that strength of commitment to the Quality Improvement Programme varied from Sector to Sector for a wide spectrum of reasons including mix of applications, application maturity, technical innovation and politics. We took great care to involve all management and staff in the change process. The diagram on the following page was used to help us plot the progress of key players in our change to a quality culture:

![Diagram showing the process of quality initiative](image)
We made extensive use of facilitators to sustain our quality culture, protect our investment in quality, education and training and combat the *yes but* brigade.

**Sustaining the Quality Culture**

For GAK, Quality Culture means:
- Competitive performance
- Continuity and sustainability
- Knowledge and fun

**The last word**

The Quality Initiative is now an integral part of GAK's processes. It is seen as successful in terms of improving business operation and is itself subject to continuous improvement.