Quality Handbook

Our path to excellence

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Quality!

We live in a world where electronics is becoming more pervasive each day. In every instance where electronics is making a positive difference to people's lives, there is ST.

We develop innovative solutions covering Sense & Power and Automotive Products, as well as Embedded Processing Solutions, that focus on increasing the quality of life. We help enrich our customers' products, to make them more efficient, more appealing, more reliable and safer.

From product conception to delivery and beyond, we work relentlessly to provide you, our customers, with the highest level of quality excellence in the semiconductor industry.

Don't just believe in our quality.

Experience it.

www.st.com

Quality strategy & roadmap

Our ambition

Quality is our priority in ST. We work hard every day to meet and exceed customer expectations. Our goal is to provide our customers with the highest level of quality excellence in the industry. We are committed to make our solutions the best, safest and most reliable in the industry.

OUR STRATEGY & ROADMAP

Our quality strategy sets the directions for reaching our goal. It defines state-of-the-art programs and processes for improving quality, combining innovative approaches and continuous improvement.

It is accompanied by a detailed roadmap for executing the strategy with clear ownership, timelines and resources for achieving all targets.

Our strategy is elaborated around seven fundamental pillars:

1. Our customers:
Delight our customers by providing best-in-class quality support, communication and management of customer requirements.

2. Change management:
Guarantee product quality excellence to our customers for any product, for any process, in any factory.

3. Product & technology development:
Achieve built-in quality at every step of product and technology development.

4. Manufacturing & supply chain:
Achieve zero excursions for our customers and best-in-class baseline defectivity.

5. People:
Engage employees in the pursuit of quality excellence by ensuring people are empowered, connected, competent and dedicated to quality.

6. Business processes, tools & indicators:
Provide the quality framework for the company business model.

7. Economic value:
Consider quality as an investment by using an economics approach that measures the value of quality to our bottom line.

What can customers expect from us?

- We will achieve the lowest levels of Defective Parts Per Million (DPPM) for each industrial domain with the ultimate goal of zero failures.
- We will prevent any impact to our customers due to excursions through robust prevention methodology and zero-excursion management.
- We will be fully engaged and flawlessly execute business processes, prevent problems and continually improve the way we work.

Quality leadership & responsibilities

OUR RESPONSIBILITIES

In ST, we are proud to have a team of highly competent, dedicated quality professionals. This team is supported by the entire ST workforce, since we are all accountable for quality in our daily jobs. Responsibilities for the core quality functions include:

Field quality service:
Supports and communicates with customers regarding requirements, issues, improvement plans, data collection, questions and feedback; collects complete information on specific customer requirements and facilitates agreements; communicates and notifies customers of product/process changes and product termination; gathers feedback.

Product quality:
Focuses on quality and reliability at all phases of the product development process; qualifies new products and materials ensuring they meet the mission profile and customer requirements for quality and reliability.

Technology & manufacturing quality:
Checks that manufactured products conform to customer requirements; secures new product qualification, change management and non-conforming material management; facilitates use of manufacturing data, tools, methods and procedures.

Failure analysis:
Performs electrical and physical analysis of products for new product debugging and reliability evaluation, yield improvement, manufacturing changes and issues, customer issues and competition analysis; applies and develops advanced analysis techniques and uses problem solving methodologies to identify failure modes and to contribute to identifying failure mechanisms.

Quality standards & management system:
Deploys and improves our quality management system and its associated processes, rules and documents; oversees compliance with ST rules and industry standards like ISO, VDA and JEDEC; benchmarks industry standards and trends.

Supplier & subcontractor quality:
Ensures supplier, subcontractor and foundry manufacturing quality is compliant to ST expectations; manages all aspects of supplier, subcontractor and foundry quality such as data analysis, changes, incidents and audits.

Software quality:
Applies quality approach to software development; ensures alignment to customer requirements.

Our quality leadership

Our quality leadership team is comprised of representatives from each ST organization who are accountable to the Executive Vice President of the Product Quality Excellence organization. This team defines the quality strategy, priorities and initiatives and drives their execution companywide. Monthly meetings are held to review results and define improvement actions.

ST is organized into product groups, geographical sales regions, operations and corporate functions. The quality function is embedded inside each organization, keeping quality leaders close to daily operations within the global ST quality framework.

Our customers

Our objective is to delight our customers by providing best-in-class quality support, communication and management of customer requirements.

Customer support structure

Customers are supported through a worldwide organization, organized into four geographical regions

- Americas
- Europe, Middle East, Africa
- Greater China and South Asia
- Japan and Korea

Customer support offices are located close to many of our customers in order to provide fast, hands-on field support. A dedicated support organization is also in place for our key accounts.

Field sales engineers and account managers are the primary customer interface. They are responsible for managing the business relationship with the customer, responding to customer requirements and ensuring that ST is able to comply with customer requirements.

ALIGNMENT TO CUSTOMER REQUIREMENTS

In ST, we work closely with our customers to fulfill their requirements and ensure compliance with all agreed customer requirements. This means

- Understanding the requirements of our customers and markets
- Comparing them with our standard operation rules and performance
- Analyzing the feasibility of new requirements not currently implemented
- Deploying agreed upon requirements
- Monitoring trends for upcoming demands and aligning ST systems to satisfy them as they become generalized

Customer requirements are classified into four categories

- Product, such as specifications, qualification, and product compliance
- Supply chain, such as delivery, inventory and logistics
- Corporate responsibility, which includes environment, social, ethics, health and safety considerations
- Commercial, such as terms, conditions and pricing.

REVIEW & APPROVAL PROCESS

We start the review and approval process by collecting complete information about the specific customer requirement.

The requirement is thoroughly analyzed to ensure that it complies with company ethics and business rules, including potential conflicts with existing contracts, local specific regulations and legal entities involved. ST adheres to the most stringent standards and regulations in our industry.

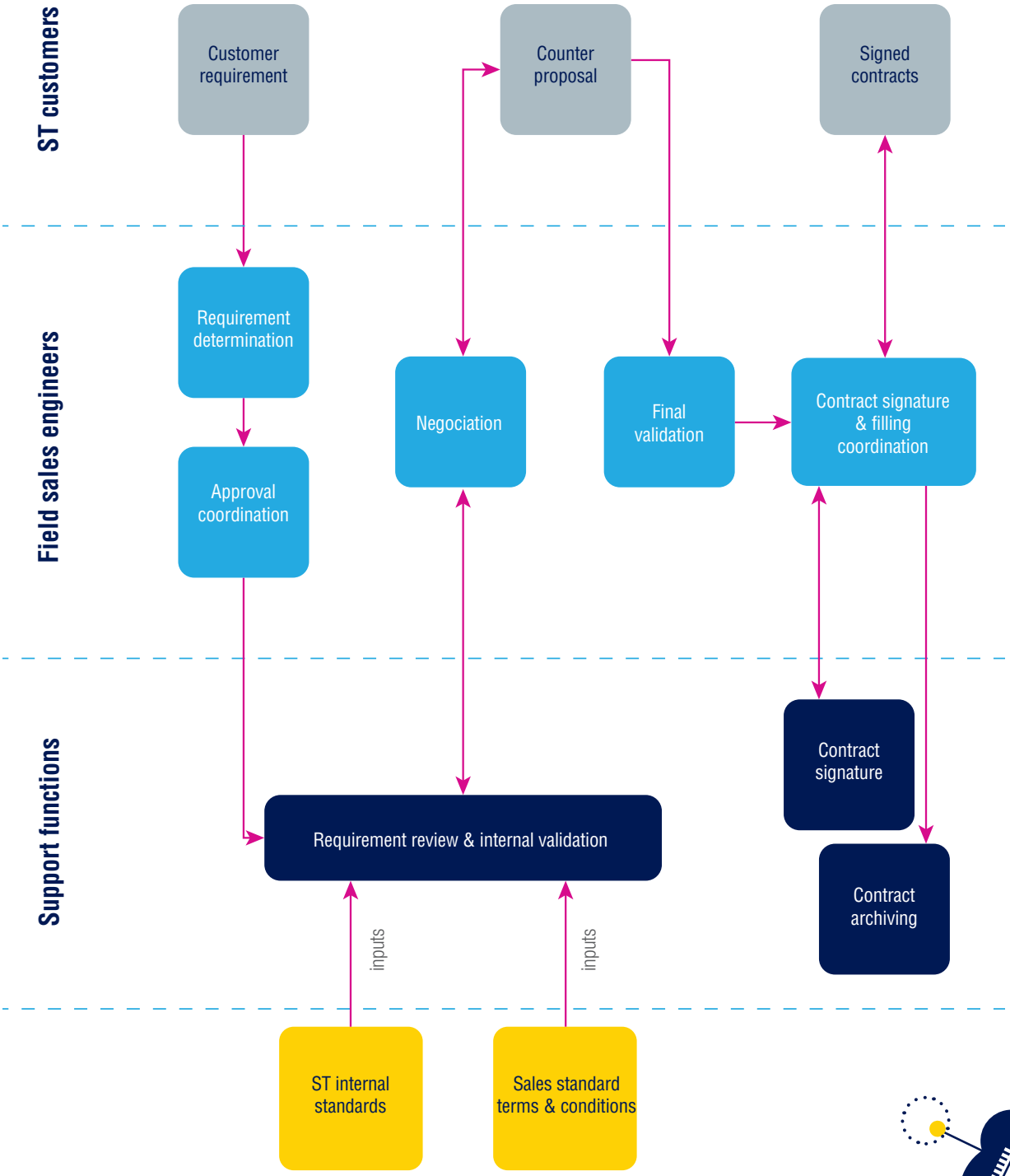
Next, we assess our ability to meet a proposed customer requirement prior to agreement in order to guarantee compliance between customer requests and the corresponding product or service.

We may request clarification about the requirement when needed, such as the intended use of the product and the statutory or regulatory requirements related to the product and/or business. A requirement may be negotiated to reach a mutually acceptable agreement.

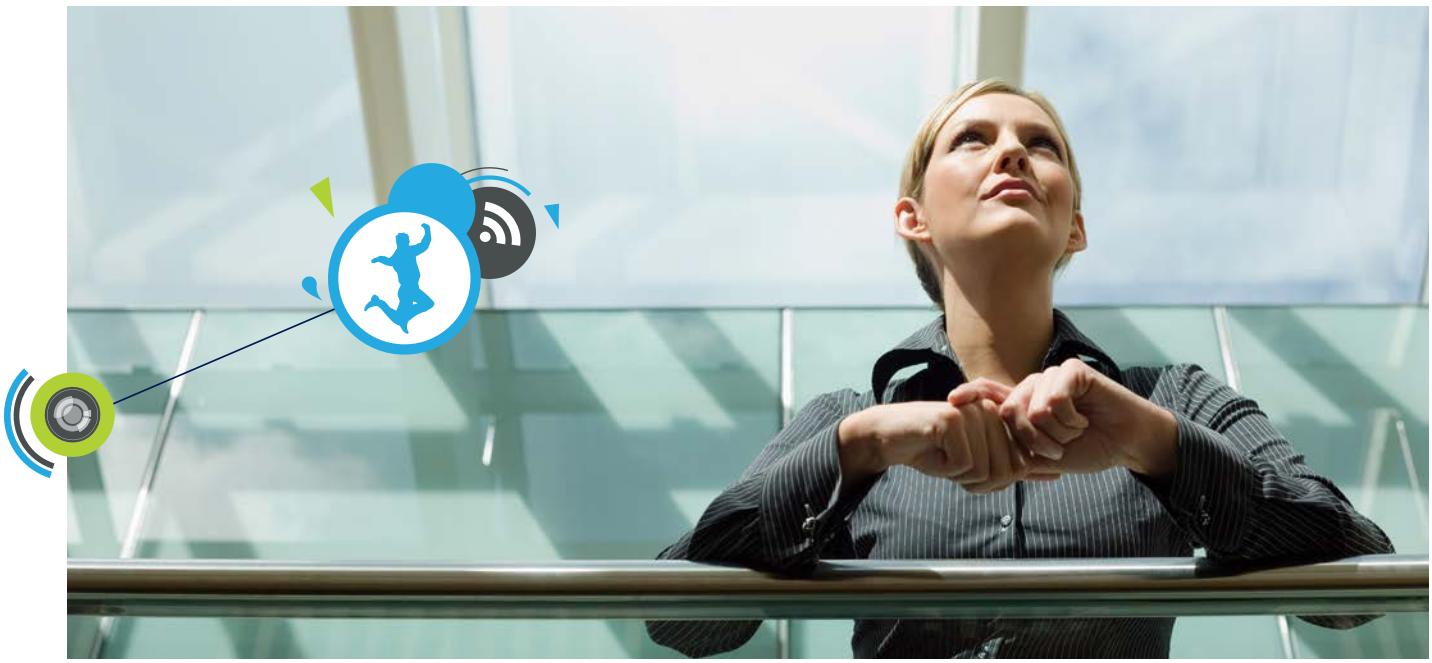
When a customer requirement is approved by ST, a formal contractual agreement is set up defining the rules for conducting business.

In this way, we are able to provide fast responses to customers and guarantee accountable and consistent execution of the agreed upon requirements as well as maintaining our system aligned to the market trends.

Customer requirements review & approval process



Our customers



RESPONSIVENESS TO COMPLAINTS & RETURNS

In ST, we are committed to respond to complaints quickly and effectively in order to protect our customers and fully resolve the root causes of a problem. Our final goal is to reduce the total cycle time for resolving a customer complaint to 14 days.

When a customer contacts ST with a complaint, we collect a detailed description of the problem and the conditions of occurrence as well as material evidence and traceability information. We use this information to identify the origin of the parts and investigate any possible incidents. Failure symptoms are also checked for possible recurrences regarding either the commercial part or the customer.

PROBLEM SOLVING METHODOLOGY

A team of experts is put into place to resolve the problem, and immediate containment actions are taken to minimize the impact on our customers, such as segregating impacted lots and inventories or rescreening parts. Next, a thorough analysis of the problem is performed, which includes

- Symptom review
- Visual/mechanical inspection
- Electrical analysis on automatic test equipment
- Complementary failure analysis tests when needed

Our analysis laboratories are strategically placed around the globe to assist in the resolution of customer complaints. They are compliant with the ISO/IEC 17025 international standard.

Confirmed problems are resolved using 8D Team Problem Solving methodology for each defect. This methodology allows us to accurately identify the root causes of a problem and take steps to keep it from happening again.

All information about the complaint is entered into ST's global complaint management system. This allows all members of the 8D team to efficiently interact and bring the necessary expertise to the problem resolution no matter where that expertise is physically located. Knowledge is cross-fertilized to avoid recurrence.

Supporting methodologies ensure that the problem is fully addressed, including

- 5 Why's: a question-asking method used to explore the cause/effect relationships underlying a problem and determine the root causes of a defect or problem, including the occurrence, escape and system root causes
- 5W2H (What, When, Where, Why, Who, How, How Much) : a question-asking method used to clarify or understand a fact in more depth
- Is/Is not: a simple method for bounding a problem and understanding its scope
- Failure Mode and Effects Analysis (FMEA): a methodology for identifying potential failure modes, determining their effect on the product, and identifying actions to mitigate the failures.

COMMUNICATION WITH CUSTOMERS

Customers are informed about the progress of the complaint resolution through appropriate communications, such as

- Acknowledgement of receipt
- Interim reports with immediate containment actions and test results
- Complaint reports with 8D analysis results.

The customer complaint is normally concluded upon acceptance of the final report by the customer or 14 calendar days after the final report is sent if there is no customer feedback (unless otherwise stated in agreed specific customer requirements). The internal activities continue until the full closure of the 8D.

Complaint resolution may also integrate specific customer requirements, when agreed upon by ST, such as methodologies, cycle time, reports, information or assessments.

RETURNS PROCESS

If parts must be returned to ST, we seek to minimize the impact for our customers. Our goal is to manage customer return requests in the shortest possible processing time by utilizing our global return management system.

Before processing a claim, it must be validated and approved by ST. Returns are deemed valid if

- The products are original ST products and have been sold by ST to the customer
- The return conforms to ST general terms and conditions of sales and, when relevant, specific contractual agreements
- The rationale for return is explicit and has been validated by ST.

Products that have been manipulated or altered and are no longer in their original form as supplied by ST are not eligible for return.

For returns linked to quality issues, a customer quality complaint analysis is launched for all returns, allowing us to identify the origin of the problem and take all needed actions to resolve it. The analysis results are required to authorize the return.

If ST approves the return request, a Return Material Authorization number is issued with shipping instructions and a credit note is issued as soon as the parts are received by the ST warehouse.

CUSTOMER SATISFACTION MEASUREMENT

One of the ways that ST measures the effectiveness of our customer-oriented processes is by measuring and tracking our customers' satisfaction.

We utilize and value the data provided by many of our customers in the form of customer score-cards. These scorecards are regularly examined, interpreted, and discussed with our customers so that we fully understand the ratings and feedback that we receive.

We also collect feedback via customer surveys and direct contact with customers. The information obtained is analyzed to derive either continual improvement or corrective actions.

The performance criteria of customer satisfaction are established based on industry benchmark data. Our performance against these criteria is regularly monitored during management reviews.

These performance measurements are essential to identifying improvement opportunities and maintaining the core principle of continual improvement, enhancing customer satisfaction.

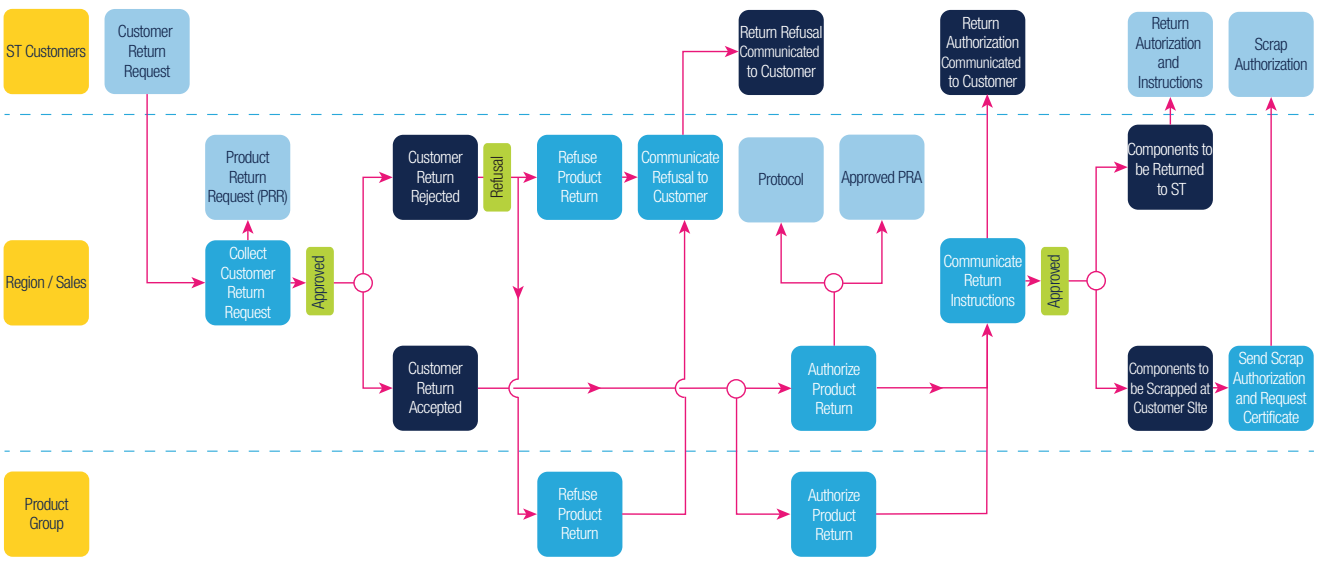
UNDERSTANDING FUTURE NEEDS & EXPECTATIONS

In ST, we do our best to anticipate the needs of our customer base and to align with their strategic direction so that product compatibility will benefit both parties in competiveness and growth.

The process involves not only understanding near future directions and needs but also looks at long-term strategies that will assure a sustainable partnership positioned within the horizon of technology advances.

With this in mind, ST is an active participant in many of the standard-setting consortia, both in our semiconductor industry as well as those of the industries of our customer base.

Customer return general flow



Change management

OUR AIM

Excellence in the management of product and process changes allows ST to improve manufacturing efficiency, which benefit all the stakeholders.

The change management is a robust process in ST, the risks and benefits of any change proposal is evaluated as first step even before to define a qualification plan.

Our overriding aim is to guarantee product quality excellence to our customers for any product, for any process, in any factory.

Our Process

The change management effectiveness is guaranteed by execution with reference to a well-defined process that drives compliance and allows for simple and effective execution, the process is supported by a dedicated tool. The execution process is developed in four steps:

1. Change proposal
2. Product/Process change assessment and classification
3. Qualification
4. Test, final approval and implementation

CHANGE PROPOSAL

Each proposed change is evaluated, taking into consideration the effect on the product or application as well as the potential manufacturing impact. This is done through a feasibility study, experimental data analysis and risk analysis.

PRODUCT/PROCESS CHANGE ASSESSMENT & CLASSIFICATION

Change proposals are analyzed by the Product/ Process Change Review Board (PCRB). Particular emphasis is given by the risk assessment.
This board is comprised of a multidisciplinary team of experts, including senior engineers and management, who evaluates then classifies, approves or rejects the change request. For each change, all potential impacts are evaluated. The following key functions are represented in the PCRB:

- Product group quality, product engineering, test and planning
- Operations quality, manufacturing, process, device, equipment, test, facilities, planning, process control
- Foundries and subcontractors

QUALIFICATION

To ensure that proposal changes do not affect the product or process performance, a list of tests is established for the qualification plan detailing the trials and actions required to qualify a change. It includes the acceptance criteria for trial lots during parametric tests, electrical wafer sort and final and reliability tests.

TESTS, FINAL APPROVAL & IMPLEMENTATION

The Product/Process Change Review Board performs a final review of all results to approve or reject the implementation of the change.
All relevant documentation, such as manufacturing specifications, operating modes and control plans, is modified to take into account the change. Our processes and system track all changes and allow for cross- fertilization for same technology or products in different plants. Once implemented, the change is monitored with particular attention to ensure the results stay consistent over time.

NOTIFICATION

Customers are notified of any modification to a product or process that may impact the form, fit, function, processing, quality, or reliability of a product, the customer supply chain, or contractual agreements with our customers. In ST, we provide customers with a Product/Process Change Notice at the soonest and respecting international standard and respecting specific customer requirements accepted by ST. Customers must acknowledge receipt of the notification requests for evaluation samples must also be made within 30 days of the notification.

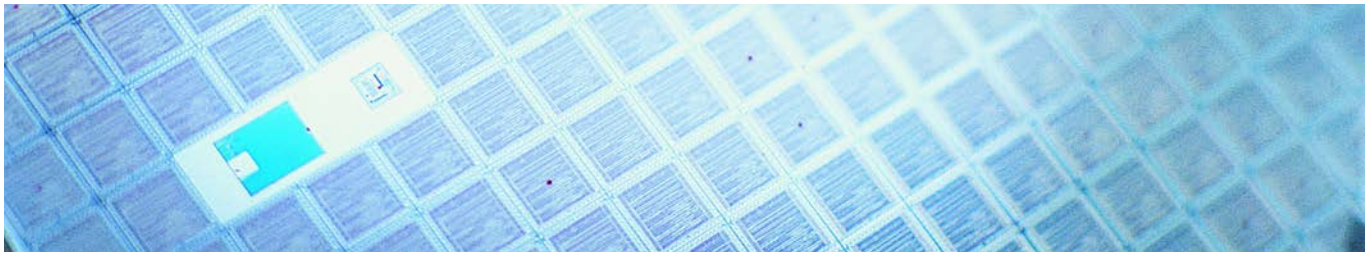
The notification outlines the reasons for the change, the advantages and the proposed qualification plan.

In the spirit of full transparency ST works in a team with customers when needed to jointly execute the qualification plan.

PRODUCT OBSOLESCENCE

Before terminating a product, we evaluate the effects and potential alternatives to protect our customers from any potential line disruption. Impacted parties are notified according to international standards and specific customer requirements accepted by ST. We provide technical data, validate potential alternatives and agree on the duties required to maintain the continuity of supplies.

Product & technology development



RELIABILITY IN PRODUCT DEVELOPMENT

In ST, we are committed to delivering products with robust and reliable performance in line with customer expectations, industry requirements and end user imperatives. We achieve this with built-in quality at every step of product and technology development.

Our product development process starts by identifying

- **Mission profile:** Conditions of use of our products, notably conditions of stress that may occur during the product lifecycle. This includes operating temperature and frequency, number of write/erase cycles, mechanical and voltage stress and other similar parameters.
- **Industry domain requirements:** The ST standard approach to fulfill the requirements of specific business domains, such as consumer, automotive, safety or medical, and standard.
- **Knowledge matrix data:** The ST knowledge base of known failure modes which allows us to exercise prevention starting in the early design phase and implement the right solutions by capitalizing on expertise and past experience.

During this stage of the product feasibility analysis, we work in cooperation with our customers and technology partners to acquire a deep understanding of critical product characteristics and use conditions. This background allows us to construct an in-depth prevention plan, which includes a similarity analysis and a full review of the technology, package and IP capabilities.

THE ADVANCED PRODUCT QUALITY PLAN (APQP)

Product development begins after the preliminary project analysis using an Advanced Product Quality Plan (APQP). APQP is used to define a product quality plan to support product development in line with customer expectations.

APQP is a tailored version of a standard quality plan, which details the trials and simulations required to validate the product throughout the development, industrialization and product launch phases. It is built by quality experts, who facilitate risk assessment, prevention and validation and enable consolidation of results with the project manager and core project team members at the earliest possible stage.

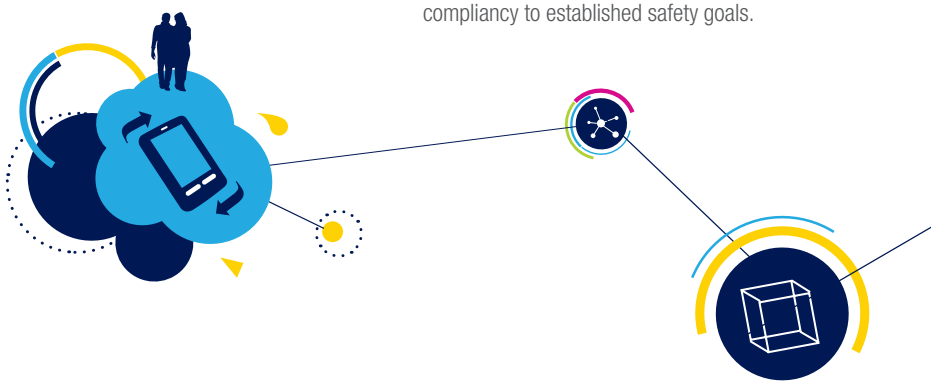
ST INDUSTRY DOMAINS

We ensure that the quality of products targeted to a specific industry domain meets this domain's expectations, including

- Applicable international standards
- Regulatory requirements
- Design, development, industrial and service best practices.

We currently serve four industry domains

1. Standard products: These products are governed by ST standard terms and conditions of sales. Specific customer requirements must be agreed upon in writing by ST.
2. Automotive products: Our automotive products are AEC-Q100 compliant. They are subject to specific stress testing and processing instructions in order to achieve the required quality levels and product stability.
3. Automotive safety: This is a subset of the automotive domain. ST has used as a reference the ISO 26262 Road vehicles Functional safety standard. We support customer inquiries regarding product failure rates and FMEDA to support hardware system compliancy to established safety goals.



We provide products that are safe in their intended use, working in cooperation with our customers to understand the mission profile, adopt common methods and define countermeasures for residual risks.

4. Medical products: We comply with applicable regulations for medical products and apply due diligence in the development and validation of these products. Our focus in this domain is:

   - The health care segment, where ST offers its best technology and IPs
   - Class III (in accordance with European Union and United States criteria) life sustaining or active implanted devices and finished medical devices that we may co-develop or produce with partners.

PRODUCT DEVELOPMENT

Design controls, tests and approvals are completed at each stage of product development to ensure the robustness and reliability of the product. Reliability evaluations are performed to assess product and process failure modes at each step of the product development cycle and determine their potential impact on product reliability.

Product reliability is checked using accelerated stress tests that reproduce field stress conditions that will occur during the product lifetime, taking into account the assembly environment and the customer mission profile. Reliability tests are based on internal and industry-wide knowledge of failure mechanisms aiming to ensure that no failure will occur during the lifetime of a product.

If new failure mechanisms are identified during these tests, they are analyzed to determine the root cause and corrective actions are taken to remove any potential reliability issues.

The validation process covers all steps defined in the quality plan, including

- design reviews
- package approval
- documentation
- reliability trials
- other necessary trials

Products are qualified after validation of final production and product configuration. The industrialization phase is dedicated to optimizing yield, test time and efficiency with improvements made during volume production.

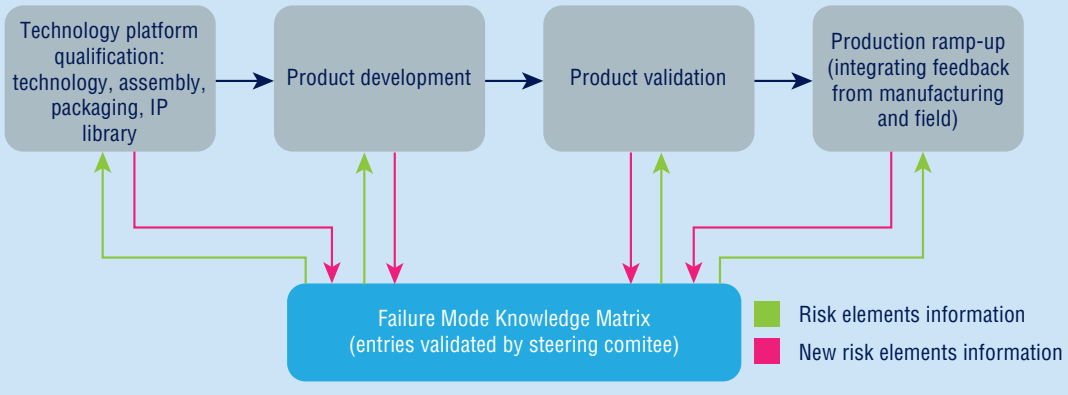
Failure mode knowledge matrix (FMKM) & know-how networking

Fully understanding product requirements and assessing potential failure modes allows us to anticipate risks from the early design phases and to implement the right solutions.

The Failure Mode Knowledge Matrix, introduced by the electronics consortium ZVEI and the American Electronics Council in 2005, provides a methodology for capitalizing on our experience and sharing our knowledge of failure modes.

In ST, we use it to capture, store and transfer in-depth knowledge and expertise so that we are able to reuse the best available knowledge and prevention solutions. We use this information during product and technology design at the level of the device, die, IP, package, subsystem, and interactions among components. The FMKM covers random, transient and design failures as well as mechatronics (MEMS), medical devices and safety application items.

Information about risks and prevention solutions is gathered during technology platform qualification, product development, qualification and ramp-up, including feedback from manufacturing and the field. Expert teams submit contributions to a steering committee, which validates proposed entries. Other experts can then access this company-wide expertise through the Failure Modes Knowledge Matrix, allowing them to identify and mitigate critical risk factors.



Product & technology development

TEST FLOW

A robust test solution, including the test program, system and configuration, is a critical component of the product development flow. It is aligned to the customer test system with exact coverage of functional patterns and tailored to detect potential risks introduced by the product or application design.

TECHNOLOGY DEVELOPMENT

We develop advanced design platforms and production technologies for silicon and packaging, integrating quality and reliability features to guarantee safe and robust industrialization. The normal path to develop a front end or back end technology or package is similar to that used for product development. This path normally takes place prior to product development but can also be concurrent to product development.

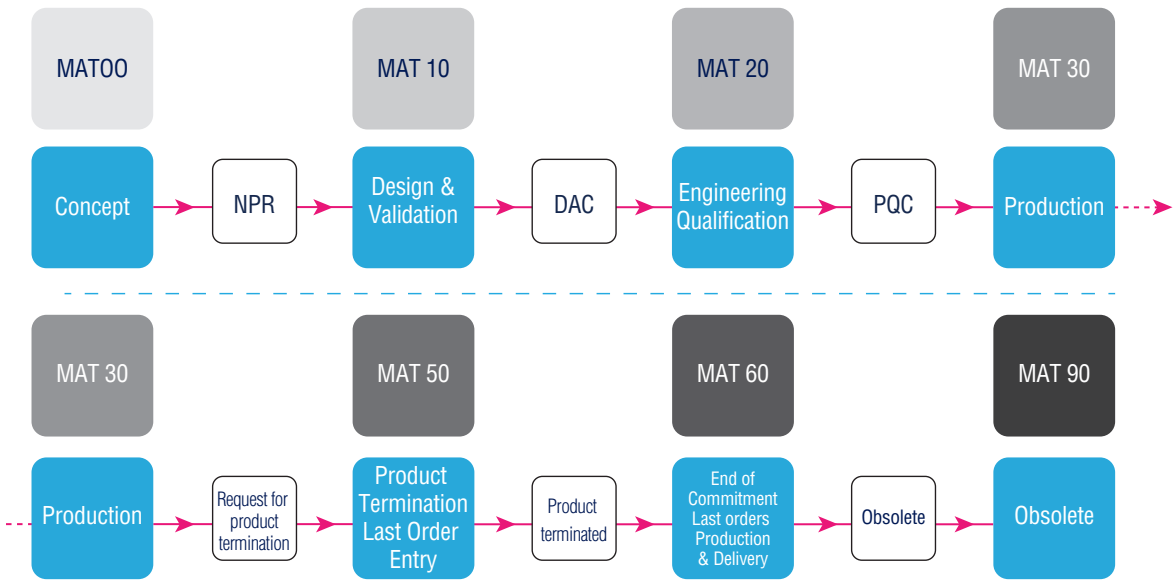
Prior to development kick-off, the mission profile, or perimeter of the technology use is validated. Potential failure modes, parasitic effects and physical effects are addressed in design kits. Statistical models allow us to simulate worst-case conditions, while characterization takes into consideration the behavior of real production equipment.

Technology is qualified at a technology review when the match between the technology perimeter and its performance is demonstrated. The intrinsic failure rate, advanced features and IP are also identified, allowing the product developer to safely use the technology with the appropriate safeguards or design and test solutions. Process monitor controls and reliability monitoring are performed during production.

PRODUCT MONITORING

We use Early Life Failure Rate (ELFR) in front end and Real Time Control (RTC) in back end to monitor products and continuously control process reliability during production. Each suspected failure is analyzed and if confirmed, a corrective action plan is implemented. Our knowledge base is refreshed accordingly for new risk items, coming also from customer manufacturing and the field.

Product maturity life cycle



NPP:
New Product Proposal
NPR:
New Product Request

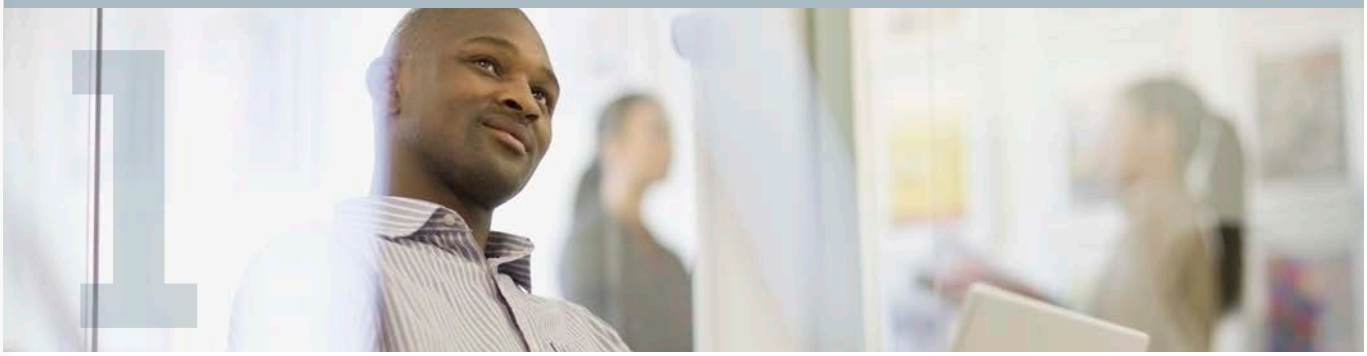
DAC:
Design Approval Certificate
PQC:
Product Qualification Certificate

PRODUCT & TECHNOLOGY DEVELOPMENT FLOW

Products can also be viewed as the result of the integration of key components. For technology, the most important ones are front end and back end technology. The development of these components is aligned with the overall product development flow. Each component has key steps and milestones. Product maturities are used to indicate the different stages in the product or technology lifecycle. Each maturity stage, from the concept to the obsolescence, is marked by a milestone requiring documented evidence and validation.

Conception

Project definition and development of technologies or products



FRONT END TECHNOLOGY DEVELOPMENT

- New platform requirements: benchmark, cost and risk analyses, applications, definition of the offer, project planning and resources, test vehicle strategy
- Technology Platform Qualification Vehicle (TPQV) strategy including all test structure requirements
- Project risk analysis to identify vulnerabilities taking into account lessons learnt from previous or similar technology platforms
- Process flow and the parametric test structure definition
- Qualification plan for the TPQV(s) based on mission profile(s)

BACK END TECHNOLOGY DEVELOPMENT

- New package requirements
- Process characterization
- Material definition (new substrate technologies, molding compounds…)
- Process integration through prototyping with selected flow charts and adapted stress assessments
- Modeling and simulation to anticipate new package behavior under stress and environmental conditions (drop test, moisture resistance, thermal cycle…)
- New drawing and feasibility assessment of new packing design to evaluate the impact on and interaction with manufacturing environments

PRODUCT DEVELOPMENT

- Key characteristics and requirements related to future uses of the devices
- Industry domain(s), specific customer requirements and definition of controls and tests needed for compliance
- Product target specification and strategy
- Project manager appointment to drive product development
- Evaluation of the technologies, design tools and IP's to be used
- Design objective specification and product validation strategy
- Design For Quality techniques (DFD, DFT, DFR, DFM…) definition
- Architecture and partitioning to make sure the software and hardware system solutions meet the target specification
- Product approval strategy and project plan

Validation

Specification development of technologies or products

FRONT END TECHNOLOGY DEVELOPMENT

- Functionality of the Technology Platform Qualification Vehicle demonstrated, plan for final qualification
- Characterization on typical silicon to demonstrate alignment with models
- Technology reliability at wafer level (and package level when necessary)
- EWS testing capability and front end/back end compatibility with corresponding FMEA
- Process flow, control plan and technology FMEA
- New material specification and Qualified Material List (QML) updated
- Preliminary front end/back end compatibility ensured

BACK END TECHNOLOGY DEVELOPMENT

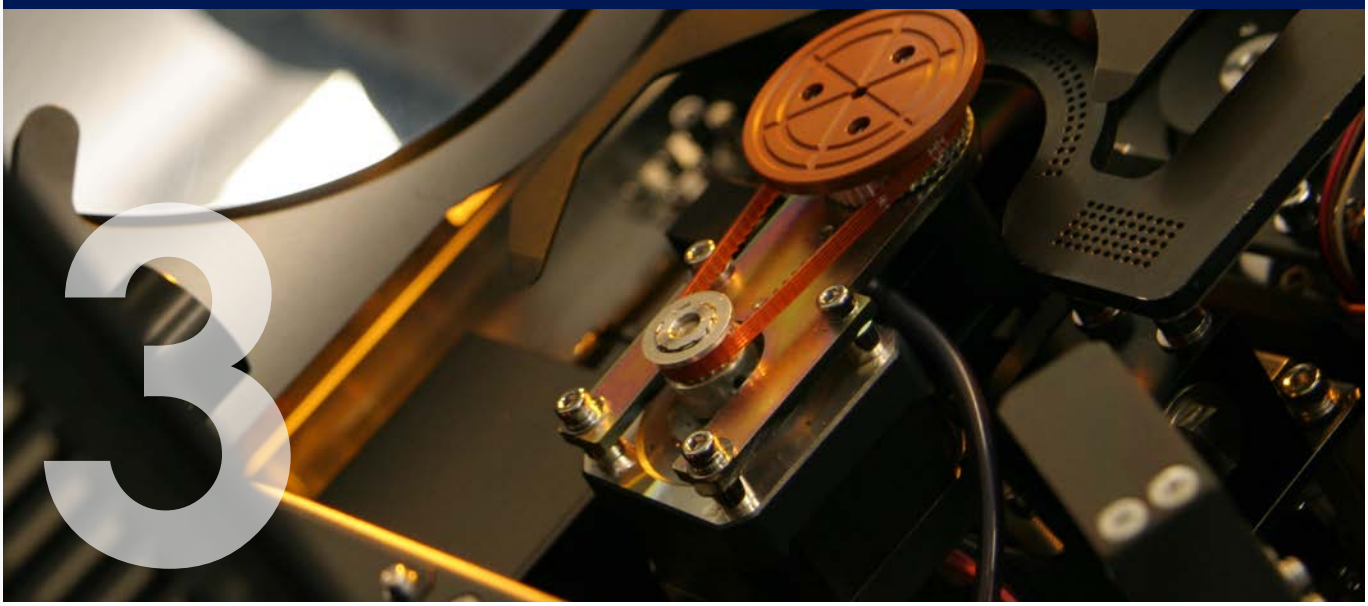
- Process parameter compatibility check with production environment conditions
- Stress qualification trials with defined parameters, materials, flow chart and control plan to validate new production environment
- Front end/back end compatibility ensured
- Secure product deliveries on advanced technologies using stress methodologies to detect potential weak parts
- Advanced design rule specification updated (if needed)
- Relevant failures identified and documented in the Failure Mode Knowledge Matrix (FMKM)
- Process FMEA, flow chart and control plan
- Process capability on all steps (attribute, variable) checked
- Equipment selection and validation
- First version of equipment FMEA for new equipment

PRODUCT DEVELOPMENT

- Analysis of new product specification to forecast reliability performance
- Reliability plan, reliability design rules, prediction of failure rates for operating life test using Arrhenius' law and other applicable models
- Use of tools and methodologies, such as APQP, DFM, DFT, DFT, DFMEA, FMKM
- Detection of potential reliability issues and solutions to overcome them
- Assessment of Engineering Samples (ES) to identify the main potential failure mechanisms
- Statistical analysis of electrical parameter drifts for early warning in case of fast parametric degradation (such as retention tests)
- Failure analysis on failed parts to clarify failure modes and mechanisms and identify the root causes
- Physical destructive analysis on good parts after reliability tests when required
- Electrostatic discharge (ESD) and latch-up sensitivity measurement

Qualification

Volume production of technologies or products



FRONT END TECHNOLOGY DEVELOPMENT

- Silicon on pre-production models based on PT measurements
- Technology platform qualification/reliability/ robustness criteria met
- Technology Platform Qualification Vehicle functionality through corner lot characterization
- Key PPAP documents (final version of process flow, control plan, PFMEA), CPK's, R&R results and assembly design rules updated
- Evidence of EWS testing capability and back end process compatibility for volume production provided
- Measurement Equipment Capability provided
- Evidence of front end production capability provided and DFM rules updated if necessary

BACK END TECHNOLOGY DEVELOPMENT

- Validation phase results meet quality, reliability and industrial robustness performance criteria
- Reliability qualification plan and line stressing completed
- Key PPAP documents (final version of process flow, control plan, PFMEA), CPK's, R&R results and assembly design rules updated
- Characterization of critical assembly process steps using Design of Experiment (DOE)
- FMEA, flow chart, control plan and documents updated with the lessons learnt in the execution of prototypes, pre-series and production risks
- Manufacturing Execution System (MES) set-up for manufacturing requirements (flow chart, control plan, yield management, logging management, people certification control…)
- Net Equipment Efficiency (NEE) of the line optimized to anticipate potential manufacturing vulnerabilities

PRODUCT DEVELOPMENT

- Successful completion of the product qualification plan
- Secure product deliveries on advanced technologies using stress methodologies to detect potential weak parts
- Successful completion of electrical characterization
- Global evaluation of new product performance to guarantee reliability in our customers' manufacturing process and in the final application of use (mission profile)
- Final disposition for product test, control and monitoring

Manufacturing & supply chain

OUR OBJECTIVES

In ST, we study every detail of the manufacturing and supply chain processes to bring our customers the highest levels of quality. We take a systematic, proactive approach to prevent and eradicate problems, cross-fertilize knowledge and continuously improve our performance.

Our objectives for manufacturing and supply chain quality are:

- Zero excursions for our customers
- Best-in-class DPPM for each industrial domain
- Best-in-class on-time delivery
- State-of-the-art supply chain processes and systems

Management commitment at all levels is critical to achieve these objectives. Manufacturing managers, from plant manager down to shift supervisors, are deeply and constantly engaged to operate in line with our approach to prevent and eradicate problems.

ABSOLUTE ZERO!

To achieve zero defects, we use a unique set of indicators that includes not only internal excursions but also data linked to manufacturing performance and smoothness. This data enables us to properly identify and prevent both internal and customer excursions.

DATA & STATISTICS

Modern computing methods allow us to exploit huge quantities of data. By applying advanced statistical methods to this data, we will achieve a breakthrough in our quality levels.

Data robustness and availability is the foundation of all manufacturing and supply chain activities. Without correct data, companies may take the wrong decisions and give the wrong information to customers. In ST, we have a dedicated quality function fully focused on ensuring data reliability.

We constantly review our approach to advanced statistics and process control, to meet higher customer expectations and requirements and to take advantage of new theoretical and software capabilities in this area. We work with statisticians to regularly update our techniques.

Advanced statistics

Our innovative approach is based on univariate and multivariate analyses. It is used during wafer and package tests to screen anomalous parts, outliers and process shifts early in the manufacturing flow and to detect variations in the process with a higher sensibility.

This approach applies to processes and equipment in both front end and back end manufacturing.

PROACTIVE IMPROVEMENT

Our approach to quality is prevention driven. We use different tools and methodologies to prevent defects from occurring or reaching customers at every phase of production, which includes design, manufacturing, assembly and test.

We act on three axes

1. Prevention during product development using methodologies such as Failure Mode and Effects Anaysis (FMEA) and the Failure Mode Knowledge Matrix (FMKM)

2. Tight process control through advanced SPC management for equipment, wafer and assembled parts. ST has its own proprietary method for outlier detection and control limit management, developed by a pool of statisticians.

3. Product screening using techniques for outlier detection, such as Part Average Testing (PAT) and Statistical Bin Limits (SBL)

For each of these axes, we work to continuously improve our quality tools and methodologies, both through systematic cross-fertilization of best practices amongst different plants and by cooperating with several universities to innovate our techniques when appropriate.

ZERO DEFECTS

Quality Improvement Plans (QIP's) are an approach we have developed in ST to reach zero defects and continuously improve our baseline defectivity in manufacturing. QIP's are used to identify, prioritize and implement opportunities for improvement, then monitor the selected improvement metrics versus the expected results.

QIP's cover the vast majority of all failure modes encountered in customer premises. The application of this methodology across the board ensures a complete and consistent approach to problem solving, root cause analysis and implementation of corrective actions. Our approach is common to all factories to facilitate cross-fertilization of lessons learnt and best practices.

"Golden flow" specifications for manufacturing are also systematically updated with lessons learnt so that all factories use equivalent, formally validated specifications.

EXCURSION MANAGEMENT

In the rare case when an excursion does occur, ST processes and IT tools allow us to quickly put into place containment and material segregation actions.

A team of senior quality and engineering experts is dispatched to work with each impacted manufacturing site to ensure we fully understand and eliminate the technical, system and escape root cause for any customer or internal excursion.

Lessons learnt are then cross-fertilized to all potentially impacted manufacturing sites, both front end and back end. Execution and completion of cross-fertilization actions are tracked to eliminate any risk of reoccurrence.

IMPROVEMENT TEAMS

Dedicated task forces to drive improvement in focus areas are led by senior quality managers. They provide insight and support in the complete understanding and correction of our most complex problems, for example:

- Compatibility issues between front end and back end manufacturing
- Verification that the manufacturing line floor plan is in line with Lean manufacturing guidelines
- Achieving a breakthrough on EOS failures.

NON-CONFORMITY MANAGEMENT

In ST, we manage all suspected non-conformities so that they do not impact our customers. Parts that cannot be recovered through corrective actions are scrapped.

When an event is detected that may indicate non-conformity, all lots related to the event are isolated and analyzed to determine if

- lots are conform, or
- lots cannot be recovered, or
- lots have one or more non-conformities

Potential non-conformities are managed by a Material Review Board comprised of experts from all concerned areas, who guarantee that appropriate actions and decisions are taken. The board analyzes data and tests to classify the event appropriately.

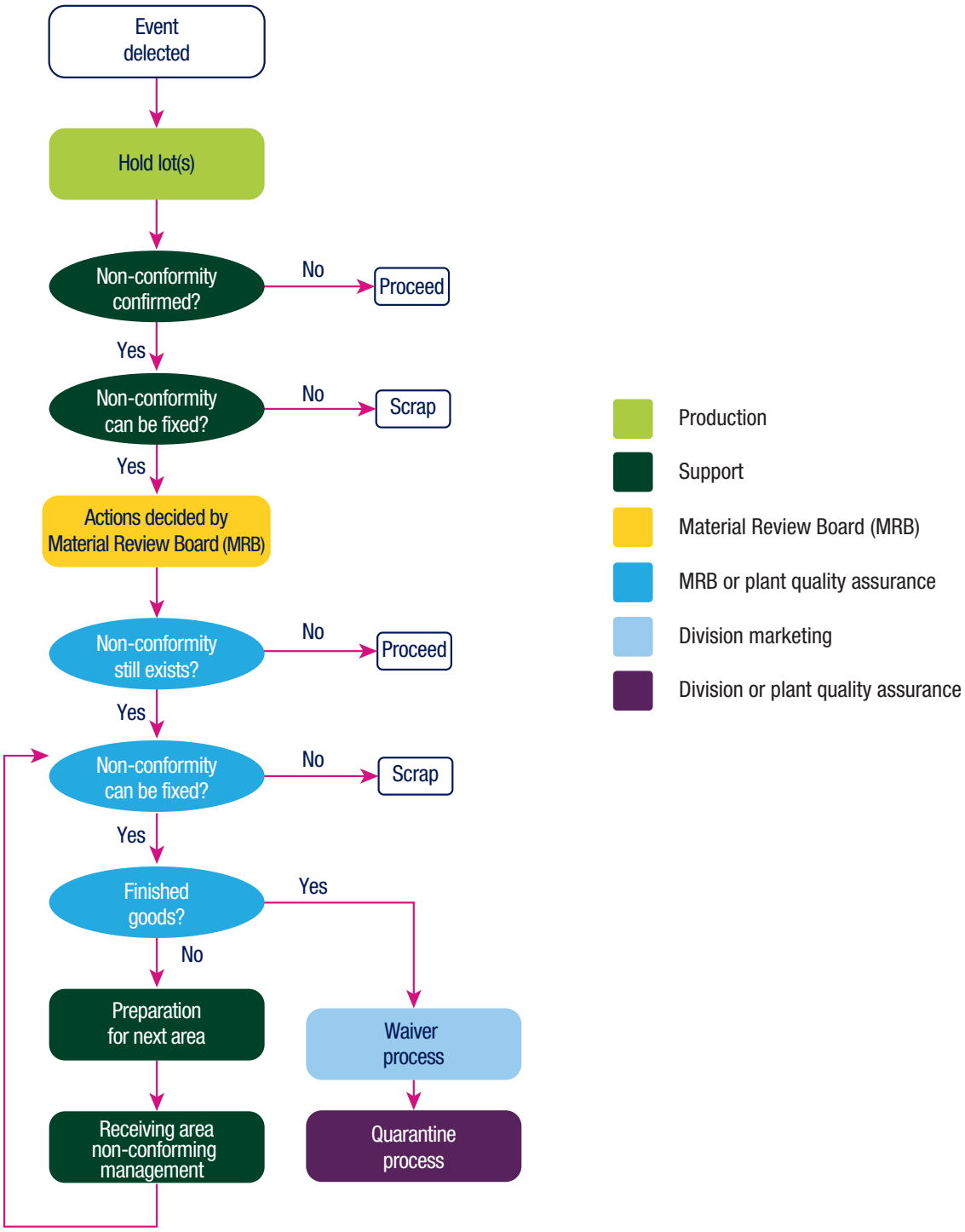
- A major non-conformity is attributed when there is a possible impact on the final product, which cannot be recovered through the standard manufacturing process.
- A minor non-conformity indicates a possible impact on the final product which can be recovered through the standard manufacturing process.

The Material Review Board ensures that 8D team problem solving methodology and risk assessment are rigorously performed for major non-conformities; decides on possible recovery actions; and makes the final decision about delivery to customers.

For all outsourced manufacturing operations, we have dedicated interfaces that ensure corrective actions are taken by our subcontractors.

After corrective actions are taken to recover the lot, a new decision is taken based on measurable acceptance criteria. All events and related information about non-conforming lots, including instructions, evidence of actions and results, are recorded to ensure full traceability.

High-level process for managing non-conforming lots



SUPPLIER QUALITY MANAGEMENT

As an integrated device manufacturer (IDM), ST has vast internal technical competence in front end and back end manufacturing and associated quality. As a consequence, and in contrast to fabless companies, we are able to deeply engage with front end and back end subcontractors both to correct and to prevent all sorts of quality issues.

We use our technical competence to perform rigorous supplier quality audits for all categories of suppliers including

- wafer foundries
- assembly, test and finishing subcontractors
- equipment suppliers
- direct and indirect material suppliers

Each of our suppliers must formally endorse the ST quality strategy and associated policies in order to provide a level of quality that is equivalent to that of our own internal manufacturing.

Suppliers are regularly evaluated through a scorecard, where quality performance weighs significantly.

SUPPLIER SELECTION PROCESS

When extra manufacturing capacity or new specialized materials or processes are requested, the process to select viable suppliers starts with a series of prerequisites, such as certification to international standards like ISO 9001 and alignment to ST requirements for quality, manufacturing capability, sustainability and specific requirements based on the industry domain.

If a supplier fulfills these criteria, a detailed evaluation is performed before engaging in the final qualification, covering items such as:

- Maturity of the Quality Management System
- Compliance to the ST list of banned substances
- Security
- Specific machine and process capabilities
- Material specifications and control methods and limits
- Process control methods

These items are verified through site audits done by the ST organization in charge of purchasing, silicon wafer manufacturing, assembly or test operations, depending on the type of supplier. Supplier lines are qualified in line with ST internal qualification methods, entailing both product qualification and site audits.

Throughout our cooperation, we monitor supplier performance and compliance to the product or service provided. Our methods are aligned to those used in our own manufacturing plants, with extensive use of data analysis and statistical process control.

The performance of each supplier is reassessed a minimum of once per year through a supplier control method. A positive evaluation is required to reconfirm qualification. The assessment includes measures like:

- Quality performance indicators
- Technical performance indicators
- Perception of internal customers
- Service and quality results from our customers
- Data integration with ST systems
- Compliance with prerequisites
- Audit results
- Performance trends versus previous evaluations

BEST-IN-CLASS ON-TIME DELIVERY & STATE-OF-THE-ART SUPPLY CHAIN PROCESSES

In ST, we manage supply chain processes to deliver our customers on time with indisputable quality. Our vision is that excellence in quality and excellence in the supply chain can only be achieved together. True quality improvements lead to better supply chain performance.

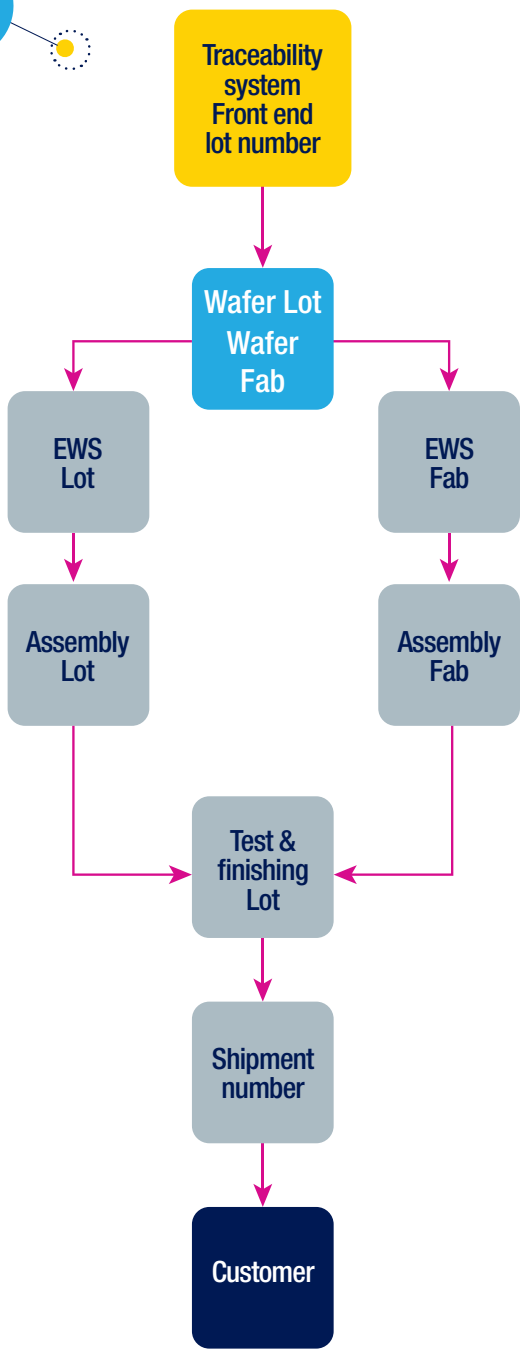
We have developed a customized set of tools to manage these supply chain and delivery activities. We continuously update our enterprise application to ensure that logistics activities are seamless and provide customers with the best possible service in terms of timing, packing and delivery customization (for example, customized labels).

TRACEABILITY

Our traceability system allows us to retrieve the individual history of any component and access complete information about it at every step in the supply chain. It is required by customers and international standards. Our ultimate goal is to achieve single device traceability.

In ST, traceability allows us to quickly identify the source of any non-conformity, determine which parts or customers may be affected and take immediate containment and corrective actions to minimize the impact.

Forward traceability allows us to move from the point of origin of the root cause of an issue to identify all products affected. Backward traceability enables us to take the product lot identification and move back in the process to assist in determining the point of origin of a problem. Traceability data from manufacturing sites, logistics and subcontractors is consolidated into a central database for full visibility at lot, wafer and die level, including direct materials for product packages, along with supplier and material lot identification.



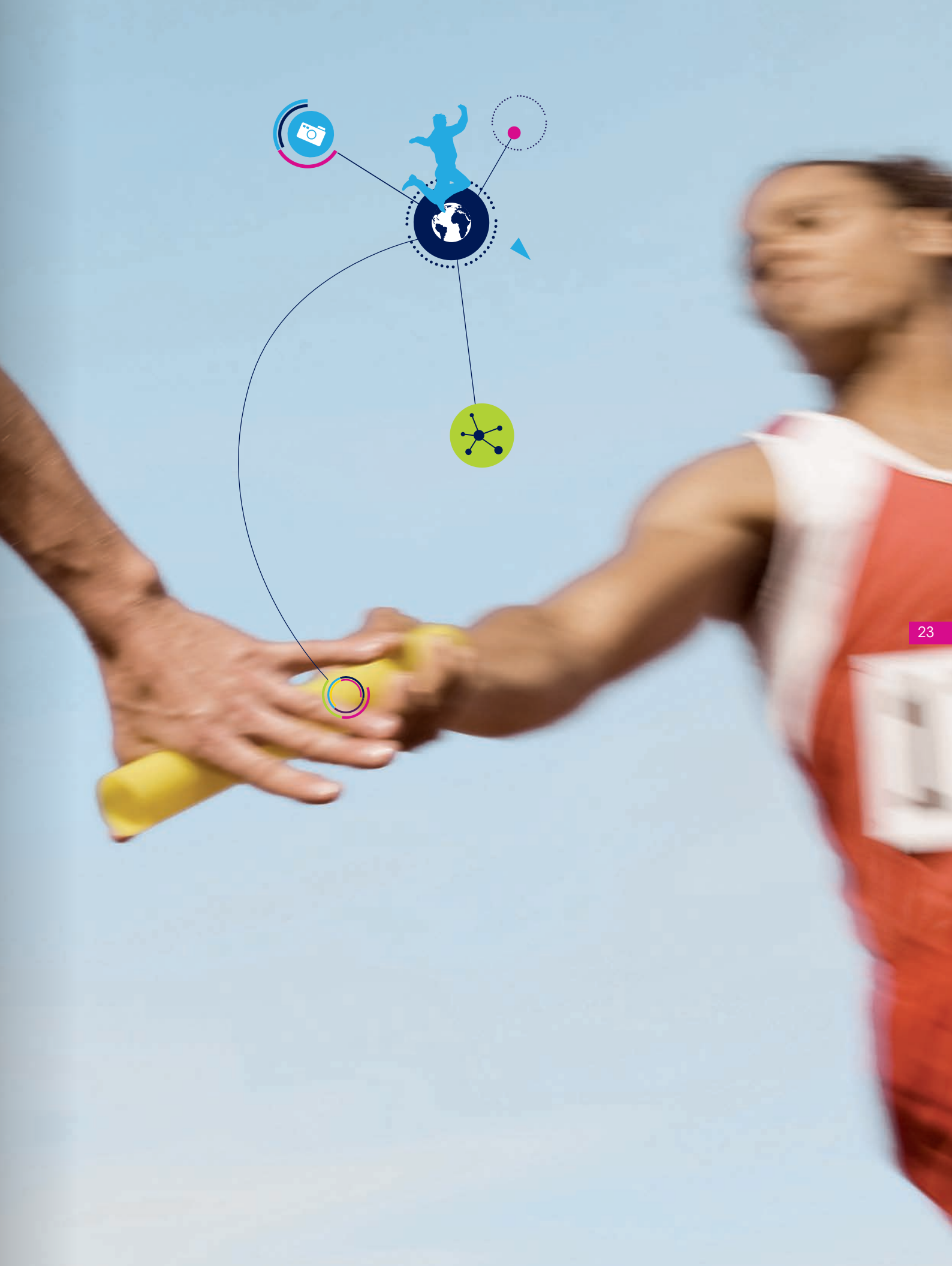
The inner box

The inner box label contains full traceability information, including

- Country of assembly
- Moisture sensitivity level as per the JEDEC standard J-STD-020
- Date of vacuum sealing of dry bag
- Peak package body temperature as per the JEDEC standard J-STD-020
- Lead-free category as per the JEDEC standard JESD96
- Product identification (ST part number)
- Bulk quantity
- Traceability code
- Bulk identification number

The inner box label guarantees that the products have been found fully compliant to the manufacturer product specification and constitutes a viable substitute for both

- Certificated of origin (country of assembly is indicated)
- Certificate of conformance (where applicable)



People

AIM FOR EXCELLENCE

Quality is part of what we do in ST, each of us, every day. Our objective is to excel in quality by cultivating a workforce of highly skilled, disciplined and engaged people and a strong company culture that aims for excellence. We achieve this through leadership, communication, networking, empowerment, and competency and career development.

GLOBAL & EMBEDDED LEADERSHIP

The Product Quality Excellence staff defines the ST quality strategy, priorities and initiatives. This team is led by the Executive Vice President for Product Quality Excellence, whose leadership team is embedded in each ST organization.

ST quality leaders make sure our quality strategy is executed. They ensure the objectives are cascaded into each organization and that the daily activities of each employee are aligned with our overall quality goals.

They are supported in this role with coaching and team building.

Our leadership model is based on four axes:

- Communicate a compelling vision
- Drive the quality strategy and execute the roadmap
- Adopt innovative techniques to make breakthroughs in quality
- Empower employees to take ownership for quality

DEPLOY THE STRATEGY

Communication initiatives allow us to share information about our quality strategy, answer questions, address concerns and gather feedback about our goals, strategy and plans. A special focus is made on technical and practical 'hands-on' content to inform and engage the community of engineers and technicians. We use a variety of channels to reach our target populations, such as conferences, audio calls, and social media.

Our Executive Vice President regularly meets employees during visits to ST sites and answers their questions at Quality Open Forums, which are open to all employees. Our Executive Vice President addresses the worldwide quality community twice per year through audio conferences in order to share customer feedback, priorities, expectations and other results, followed by a live question and answer session.

Employees get weekly updates on our quality blog, which includes video interviews from quality managers and experts on strategic quality topics. People are encouraged to ask questions and provide their bottom-up feedback from the field.

CONNECT & SHARE

ST's cross-organizational quality networks provide opportunities for people to meet, learn from each other and share knowledge, know-how and good practices. These strong partnerships and connections create an environment for people to collectively find solutions to our business challenges.

Dedicated specialist networks focus on key quality domains, such as prevention, failure analysis and problem solving. Workshops are organized on strategic topics, while "Tell me more" conference calls allow interested employees to stay abreast of operational quality topics, such as new tools and programs.

ST quality experts participate in external quality networks, events and industry associations in order to better understand industry trends and challenges, benchmark our activities and discover good practices. ST also builds partnerships with universities and other research institutes on quality-related topics.

EMPOWER & ENGAGE

In ST, people are valued and fundamental to our company's performance and success. We seek to engage and empower our people through

- Communication of our goals, strategy and expectations
- Clear individual role and responsibilities within quality processes
- Opportunities for career development, evolution and mobility
- Continuous learning and skills improvement
- Networking and team-based working methods

ST performs a yearly worldwide employee survey to assess employee engagement. The results are communicated and improvement priorities are decided and implemented by the management with the contribution of ad hoc taskforces. We conduct regular pulse checks, interviews and surveys to accompany organizational and other changes when needed.

LEARNING & CERTIFICATION

Achieving excellence demands that people perform their jobs with a high level of skill, competence and discipline. We assess performance needs, looking at current and future business and technical challenges and addressing them through the appropriate means. We invest significantly in employee training and development, including employee induction, job skills training and certification. Quality core competencies are developed through training programs, notably on quality processes, methods and tools. Tailored training programs help build the required technical competencies defined in our quality roadmap. Certification is required for critical quality activities, and we place a high value on adherence and respect of procedures.

Certified internal quality trainers ensure effective and consistent deployment of quality training. A strong focus is given to putting learning into practice on the job, which is supported by coaching and tutoring through our network of quality specialists.

We evaluate the effectiveness of our efforts to check that they are really contributing to better workplace performance. The ultimate objective is to ensure that our learning solutions contribute strongly to improved quality performance in ST.

Business processes tools & indicators

OUR FRAMEWORK FOR CUSTOMER SATISFACTION

Customer requirements drive our Quality Management System. Understanding customer requirements is a vital and integral part of the quality framework to help ensure customer satisfaction in every aspect of our business, covering.

- Compliance with internal and external requirements, focusing on customer expectations
- Complete, consistent and fool-proof quality systems and processes
- A robust system that adds value while fostering innovation.

CONTINUOUS IMPROVEMENT

Continuous improvement is a fundamental part of our ST culture and fully integrated in quality management. It is part of what we all do in ST, every day, to ensure our performance meets or exceeds our customers' expectations and our business goals.

We work to continuously enhance our overall effectiveness and efficiency through close examination of how each of our business processes is managed and interrelated using a system approach. This means

- Clearly mapping business processes and responsibilities
- Measuring and analyzing business performance
- Constantly tailoring, innovating, implementing changes and evaluating their effectiveness.

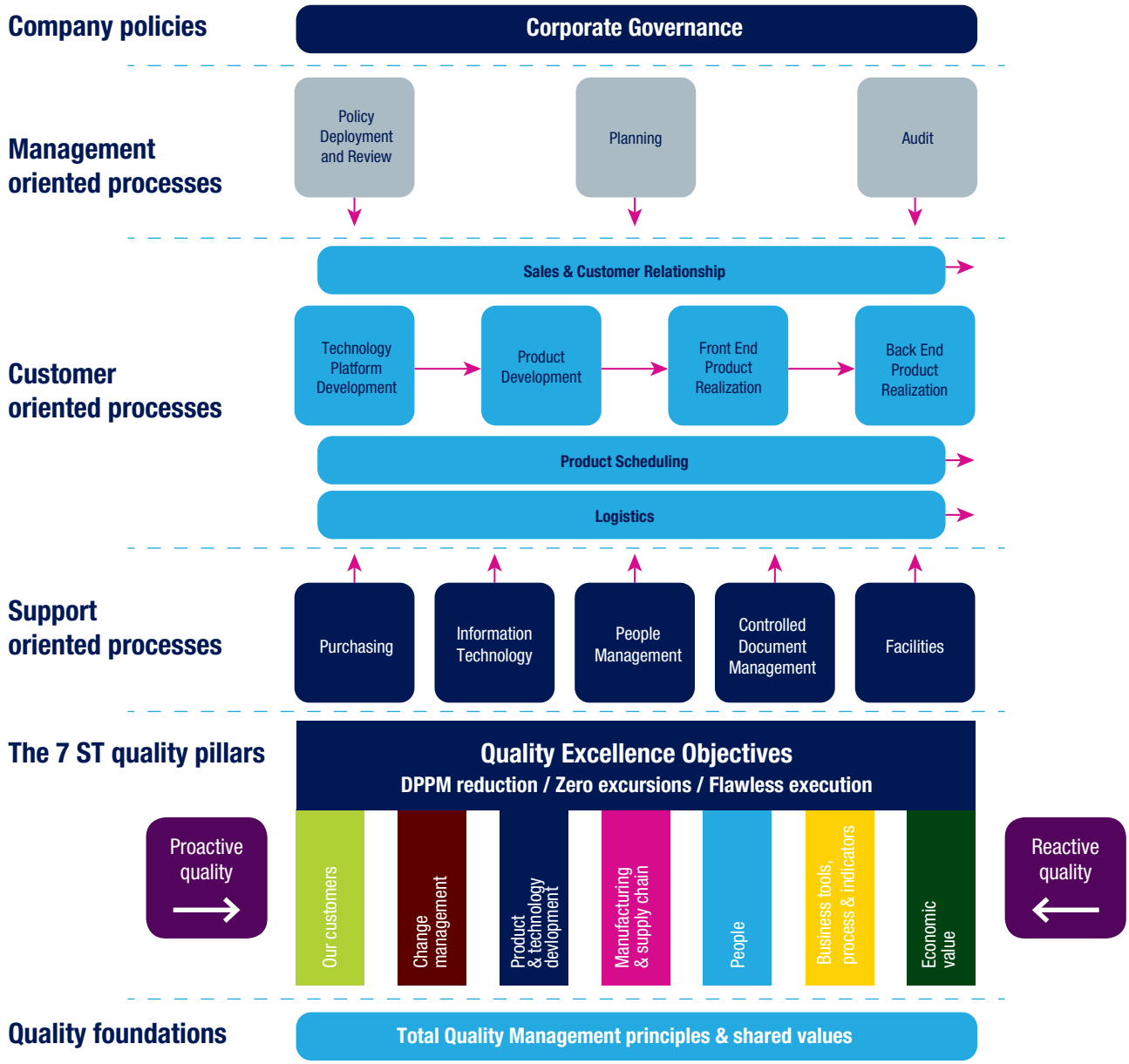
The continuous improvement process is supported by a Plan-Do-Check-Act (PDCA) approach to making decisions and managing business.

SHARED FOCUS

Our process-based model gives a global view of all activities and their interactions, ensuring the involvement of all contributors to ST policy.

Company strategy is deployed through an annual policy deployment and review process. The ST vision is broken down into achievable goals, which are cascaded into the individual objectives of each employee, ensuring efforts are synchronized and focused.

The ST quality framework



Business processes tools & indicators

CLEAR DIRECTION

Rules and instructions for executing work activities consistently and accurately are systematically documented and deployed, within a structured hierarchy of controlled documents, such as

- Governance and policy documents
- Manuals
- Processes
- Procedures and specifications
- Working instructions
- Forms and records.

SUPPORTING TOOLS, METHODS & SYSTEMS

ST quality processes are supported by a dedicated suite of tools, methods and systems used throughout the company to

- Ensure a robust and consistent approach
- Provide a platform for sharing knowledge and good practices
- Measure performance data to drive improvement.

INDICATORS

Key process indicators are used to track and measure our performance. These are fully integrated into our strategy and cascaded down to each activity, allowing us to measure both our global effectiveness and individual results. Corrective actions are taken when gaps between actual and desired achievements are identified.

AUDITS

In ST, audits are used as a management tool to assess the execution and conformity of our processes and organizations. Product conformance and organizational compliance are evaluated during the annual audit program covering ST entities, manufacturing plants, key processes and other interrelated activities and organizations.

The primary focus of audits is risk analysis. In ST, we have introduced several means to achieve effectively this purpose:

- Systematic use of VDA6.3 methodology as the master tool for assessing the capability of customer-oriented processes
- Promoting the automotive audit process approach when auditing system processes (CAPDo) and maturity performance for entities and processes based on international (ISO9004) and French (FDX on Process Management) standards
- Collaboration with Enterprise Risk Management (ERM)
- Corporate-level risk mapping and prioritization analysis
- Systematic reporting of audit major non-conformities and corrective action follow-up

ENTREPRISE RISK MANAGEMENT

Anticipating risks must be embedded into every decision we make. In ST, enterprise risk management (ERM) covers the methods and processes used to manage potential risks in order to secure our strategy, enhance decision making processes and achieve excellence in execution.

Our goal is to embed ERM into our organization and key processes to bolster risk awareness and ultimately innovation through informed risk-taking anticipation versus reaction.

ERM process implementation and risk identification combines both top-down and bottom-up approaches. “Risk owners” across the company cover top down implementation for our main risk areas, elaborating mitigation plans. Bottom-up implementation gives us in-depth understanding of our highest priority risk scenarios, helping us identify and escalate new or emerging risks.

AUDIT OBJECTIVES

Assessment of the compliance & the effectivness of the QMS

Management system & system key process
Process approach deployment & effective implementation

Assessment of the quality capability from the stand point of the product risk and industrial impact (sequence of operations)

Customer oriented process
Industrial process execution & robustness

Assessment of quality characteristics of a product to determine if it meets specifications (conformance)

Product
Effective quality control

Deep technical investigation & system root cause analysis related to quality issues

Technical
Execution & robustness improvement

Assessment of manufacturing execution impacting quality versus requirements (according to 5M / 6M methodology)

Shop floor
Prevention

CERTIFICATE N. 9170.STM1

WE HEREBY CERTIFY THAT THE QUALITY SYSTEM OPERATED BY

STMICROELECTRONICS NV
HEADQUARTERS in
39 CHEMIN DU CHAMP-DES-FILLES - 1228 GENEVA - CH

Business, Sales and Central Functions (see annex 1)
Manufacturing Functions and related Sites (see annex 2)
Supporting Functions and Other Entities (see annex 3)

IS IN COMPLIANCE WITH THE STANDARD

ISO 9001:2008

FOR THE FOLLOWING ACTIVITIES

Design and manufacturing of semiconductor products and subsystems

Refer to the Quality Manual for details concerning the application of ISO 9001 requirements

THE USE AND THE VALIDITY OF THE CERTIFICATE SHALL SATISFY THE REQUIREMENTS OF THE RULES FOR CERTIFICATION OF MANAGEMENT SYSTEMS

DATES: FIRST CERTIFICATION 1997-12-19 | CURRENT ISSUE 2012-11-22 | EXPIRY 2015-11-21

IMQ S.p.A. - VIA QUINTILIANO, 43 - 20138 MILANO

EA: 19

CERTIFICATE 9136.STM2

WE HEREBY CERTIFY THAT THE QUALITY SYSTEM OPERATED BY

STMICROELECTRONICS NV
HEADQUARTERS in
39 CHEMIN DU CHAMP-DES-FILLES - 1228 GENEVA - CH

Operative Unit of Agrate
Via C. Olivetti 2 20864 Agrate Brianza (MB) IT
Supporting Functions: see annexes 1, 2

IS IN COMPLIANCE WITH THE TECHNICAL SPECIFICATION

ISO/TS 16949:2009

FOR THE FOLLOWING ACTIVITIES

Design and manufacturing of semiconductor wafers for back end plants or direct sales

Having been assessed in accordance with "Rules for achieving IATF recognition 3rd Edition"

FIRST ISSUE 2003-12-19 | CURRENT ISSUE 2012-10-03 | EXPIRY DATE 2015-10-02

IATF: 0148237

IMQ S.p.A. Via Quintiliano 43 20138 Milano Italy

p. Presidente
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Geneva (Switzerland) - Agrate, Catania (Italy) - Ang Mo Kio, Toa Payoh (Singapore) - Bouskoura (Morocco) - Calamba (Philippines) - Crolles, Rousset, Tours (France) - Longgang, Shenzhen (China) - Muar (Malaysia) Kirkop (Malta)

PRODUCT ENVIRONMENTAL COMPLIANCE

In ST, we have adopted the most stringent Environment, Health & Safety regulations worldwide, which are rigorously applied in all sites and organizations. Our list of banned chemicals meets the most stringent worldwide regulations and is in accord with our customers' requirements.

ST complies with all laws and regulations regarding material declaration and the elimination of chemical and hazardous substances used in products and manufacturing. This includes

- RoHS and REACH: ST meets applicable worldwide product environmental regulations and requirements related to our products and services, including those stipulated by the European Union Restriction of Hazardous Substances (RoHS) and the European Union Regulation, Evaluation, and Authorization of Chemicals (REACH).
- Lead-free: ST devices are qualified to ensure their resistance to the soldering temperatures for tin-lead solder requested by PC board mounting with tin-silver-copper alloys.
- Material declaration: ST has adopted the IPC-1752 standard for reporting declarable substances and material groups. The ST list of banned, exempted and declarable substances is regularly reviewed to include regulations and customer requirements and ensure our suppliers respect our rules regarding the use of chemicals and hazardous substances.
- ECOPACK program: This is a voluntary and strategic program to remove polluting and hazardous substances from all product lines. It is a cornerstone in our effort to be a leader in moving to environmentally friendly packaging.

ST anticipates compliance with laws and regulations regarding material declaration and the elimination of chemical and hazardous substances from its products and manufacturing processes. Changes that may derive from such evolution and that impact our products are communicated to our customers through the change management process.

Certifications

An effective quality management system allows us to improve operational efficiency and productivity and to provide better quality products. It is a backbone to achieve our goal of becoming the quality benchmark in the semiconductor industry.

In ST, we adhere to the internationally recognized quality management standards ISO 9001 and ISO/TS 16949. ST received its first company-wide ISO 9001 certification in 2003, and this certification has been renewed every three years since that time.

ST manufacturing sites are certified to the Environment, Health and Safety norms ISO14001, OHSAS18001, and the Environmental Management and Audit Scheme (EMAS). Front end manufacturing sites are working to implement the ISO50001 standard for Energy Management.

Economic value

GOOD QUALITY IS GOOD BUSINESS

In ST, we have unparalleled commitment to quality in order to satisfy customer requirements. We are convinced that good quality for our customers is good business for us.

We are convinced because we evaluate quality results and have established a strong and measurable link between quality and financial performance in ST.

ST performs a systemic and 360 degree assessment of the final impact of quality on company P&L. Our approach is to calculate the contribution of quality activities to the bottom line through an innovative and comprehensive economics approach that goes well beyond the standard cost of quality/cost of non-quality assessments.

The ST model in fact captures both costs and induced savings. This gives our top management a clear means to drive strategy and business execution.

Economic assessment is performed using an algorithm that takes into account all potential impacts of quality on our business performance, enabling us to drill down all the way to variations at the product level.

The economics aspect of quality is deeply interconnected with all activities in our quality strategy and roadmap. We use it as a systematic management tool to focus spending in ways that maximize quality excellence for our customers.

life.augmented

Reference : BRHBOOKQ0313

For more information on ST products and solutions, visit www.st.com