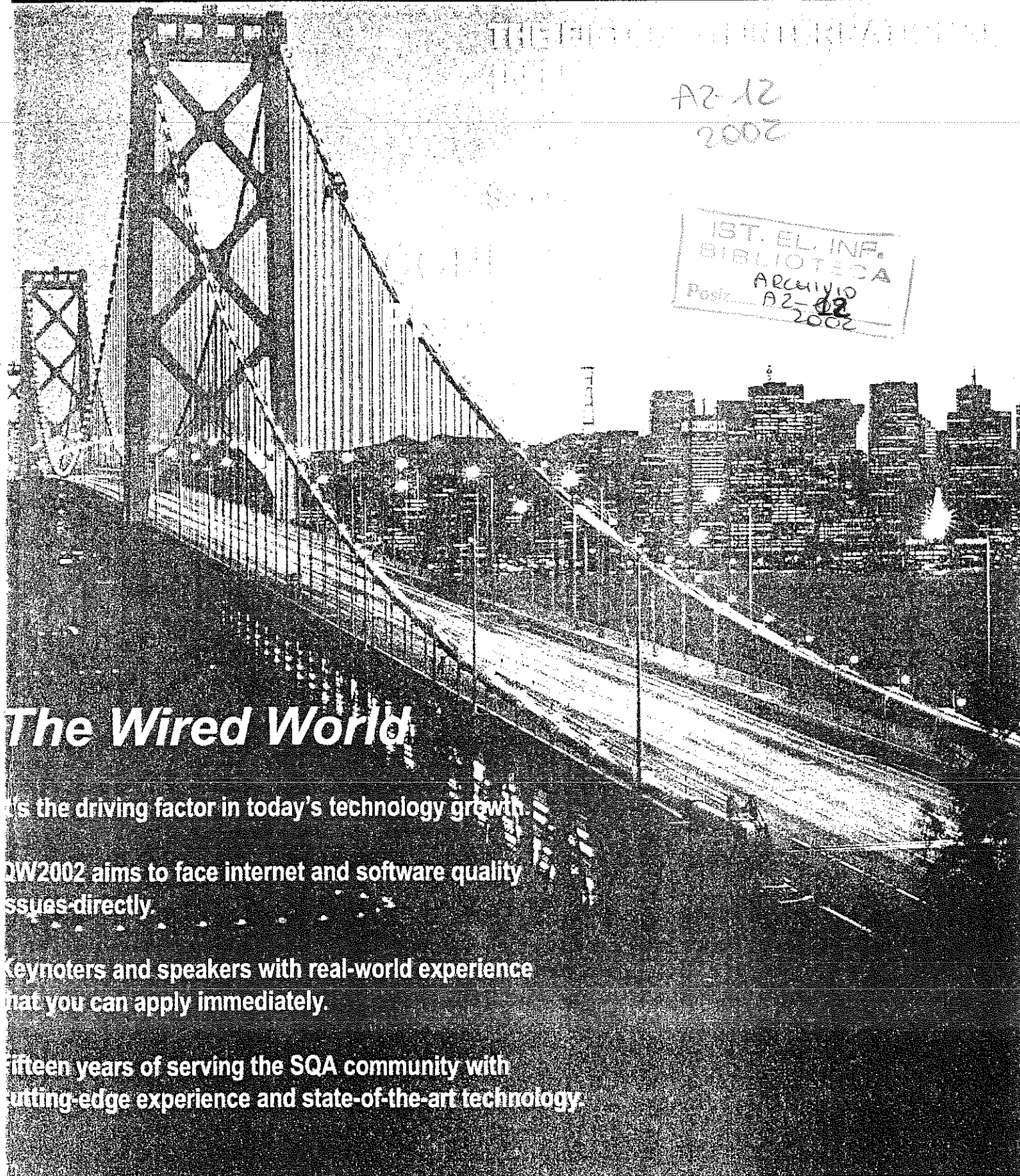


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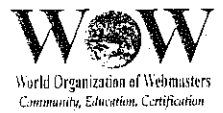
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San Francisco, California

Using Software Process Assessment to Manage the Quality of Suppliers: an Experience in Automotive

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¹ISTI-CNR, Pisa, Italy
²FIAT Auto, Torino, Italy

Vehicle electronic networks

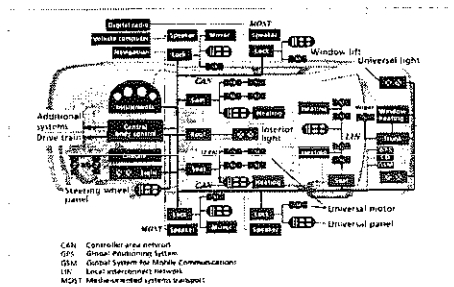
- Comfort electronics
 - ✓ Seat and window movement
- Real-time critical functions
 - ✓ Cruise control
 - ✓ Antilock brakes
 - ✓ Engine management
- Multimedia applications
 - ✓ GPS, DVD
 - ✓ Internet
- Wireless applications
 - ✓ Tyre pressure control
 - ✓ Access control

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Vehicle electronic networks (Body electronics)



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Vehicle electronic networks Emerging solutions

- More specialized and reliable control networks for X-by-Wire systems
 - ✓ Brake by wire
 - ✓ Steer by wire

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Project Participants



Fiat Auto

P&PE - ACEE - E&SI
Software Methodologies



Center for Software Certification
Consiglio Nazionale delle Ricerche

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Center for Software Certification

- The Center for Software Certification (CCS) is an organism of the Italian National Research Council that performs independent certification activity in the area of Information Technology
- CCS is part of ISTI, an Institute of the Italian National Research Council that performs research in Computer Science, information Technology and related application areas, mostly within the framework of national and international research projects

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Center for Software Certification

- Certification models and methods are founded on the long acquired competencies of the ISTI and on public domain standards as well
- CCS staff members participate in national and international Working Groups for ISO standard definition in the field of Software Engineering

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Center for Software Certification

The Center has been active since 1984, providing services to national and international customers, in the following fields:

- Software Product Evaluation [ISO/IEC 9126 & ISO/IEC 14598]
- Software Product Evaluation and Certification according to defined requirements and standards
- Software Process Assessment (*process improvement, capability determination*) [ISO/IEC 15504, SPICE]

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Fiat Auto

Product & Process Engineering
Electronic & System Engineering

Tasks

- To define requirements (HW, SW, communication, reliability, etc.) for the electronic systems and components used in all Fiat, Lancia and Alfa Romeo vehicles.
- To define requirements for the vehicle "body" electronic systems
 - Lock-unlock doors, passive entry system, anti-theft system, seat movement, windows, mirrors, etc.

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Fiat Auto

Product & Process Engineering
Electronic & System Engineering

Objectives

- To monitor the Software technologies used in the embedded electronic systems
- To use standard methodologies in order to evaluate the "process capability" of the suppliers
- To control the software life-cycle of the embedded systems
- To define and apply methodologies to validate functional requirements of the embedded systems.
- To define the SW architecture used in embedded systems

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Issues in automotive

- *The number of software-based components in automotive systems is increasing:*
 - Need to control the development cost of software-based component.
 - Need to manage the development of the software-based component, to increase the quality of the final products.
 - Need to define new relationships with the suppliers, to better manage sw-based component.

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The ESCAPE Project Goals

- To set up a methodology supporting the management of software projects and suppliers
- To improve FIAT process to select suppliers
- To improve the software development process of suppliers
- To provide FIAT with methods to determine the risks associated to software suppliers
- To give FIAT a better control on the software development project and on the quality of the resulting product

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The ESCAPE Project Action Plan

1. Selecting a methodology
2. Selecting suppliers
3. Assessing the software process
4. Defining improvement plans
5. Conducting "maintenance" assessments

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Reasons for SPA

- **Software Process Assessment is a way to better understand (and manage) the software process development of a supplier. The assessment is done to:**
 - ✓ define a "capability" level and a "risk" level for each supplier
 - ✓ have a criterium to choose suppliers based on their "capability"
 - ✓ understand weak and strong areas of the development process
 - ✓ define better functional requirements
 - ✓ define better system verification and validation procedures

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Reasons for SPICE

- Definite software-oriented approach
 - Applicability over a wide range of application domains, businesses and sizes of organizations
 - Output as process profiles at different levels of detail
 - Comparability, reliability and consistency of results
 - Independence of organizational structures, life cycle models, technologies and development models
 - Adaptability of the assessment scope to cover specific processes of interest
 - Re-usability of assessment results, both for process improvement and capability determination
- SIG on Automotive Initiative

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Assessment Preparation

- **Planning the Assessment**
 - ✓ On-site visit
 - ✓ Time/Cost constraints
 - ✓ Technical constraints
 - ✓ Assessment risk identification
- **Defining the Assessment Purpose**
 - ✓ Capability Determination
 - ✓ [Process Improvement]
- **Defining the Assessment Scope**
 - ✓ Process Selection

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Assessment Preparation Assessment Scope

1. **Requirements elicitation process (CUS.3)**
2. **System requirements analysis and design process (ENG.1.1)**
3. **Software design process (ENG.1.3)**
4. **System integration and testing process (ENG.1.7)**
5. **Project management process (MAN.2)**

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CUS.3 Requirements elicitation process

- **Process purpose:** to gather, process and track evolving customer needs and requirements throughout the life of the software product/service so as to establish a requirement baseline that serves as the basis for defining the needed software work products.
- **Process outcomes:**
 - continuing communication with the customer will be established
 - agreed customer requirements
 - a mechanism will be established for continuous monitoring of customer needs
 - a mechanism will be established for ensuring that customers can easily determine the status and disposition of their requests
 - enhancements arising from changing technology and customer needs will be identified and their impact managed

ENG.1.1 System requirements analysis and design process

- **Process purpose:** to establish the system requirements (functional and non-functional) and architecture, identifying which system requirements should be allocated to which elements of the system and to which releases.
- **Process outcomes:**
 - requirements of the system will be developed that match the customer's stated needs
 - a solution will be proposed that identifies the main elements of the system
 - the requirements will be allocated to each element of the system
 - a release strategy will be developed that defines the priority for implementing system requirements
 - the system requirements will be approved and updated as needed
 - the requirements, proposed solution, and their relationship will be communicated to all affected parties

ENG.1.3 Software design process

- **Process purpose:** to define a design for the software that implements the requirements and can be tested against them.
- **Process outcomes:**
 - an architectural design will be developed that describes the major software components that will implement the software requirements
 - internal and external interfaces of each software component will be defined
 - a detailed design will be developed that describes software units that can be built and tested
 - consistency will be established between software requirements and software design

ENG.1.7 System integration and testing process

- **Process purpose:** to integrate the software component with other components, producing a complete system that will satisfy the customer's expectations expressed in the system requirements.
- **Process outcomes:**
 - an integration strategy will be developed to build system unit aggregates according to the release strategy
 - acceptance criteria for each aggregate will be developed to verify compliance with the system requirements allocated to the units
 - system aggregates will be verified using the defined acceptance criteria
 - an integrated system demonstrating compliance with the system requirements will be constructed
 - test results will be recorded
 - a regression strategy will be developed for retesting aggregates or the integrated system, should a change be made
 - regression testing will be carried out as necessary

MAN.2 Project management process

- **Process purpose:** to identify, establish, coordinate and monitor activities, tasks and resources necessary for a project to produce a product and/or service meeting the requirements.
- **Process outcomes:**
 - Definition of the scope of the work for the project
 - Feasibility evaluation of achieving the goals of the project with available resources and constraints
 - Estimation of the tasks and resources necessary to complete the work
 - Identification of the interfaces between elements in the project, and with other projects and organizational units
 - Development and implementation of the plans for the project execution
 - Actions to correct deviations from the plan and to prevent recurrence of problems identified in the project will be taken when project targets are not achieved.

Project implementation pre-assessment activities

- **Introductory meeting**
 - ✓ To introduce the SPICE (ISO15504) approach
 - ✓ To review the assessment purpose, scope and constraints
 - ✓ To introduce the assessment activities and the provisional assessment plan
- **Pre-assessment questionnaire**
 - ✓ To gather preliminary information on the projects to be used as process instances

Project implementation on-site activities

- **Briefing**
 - ✓ Assessment purpose, scope, constraints and model
 - ✓ Confidentiality policy
 - ✓ Assessment schedule
 - **Data Acquisition & Validation**
 - ✓ Presentations
 - ✓ Document analysis
 - ✓ Interviews
 - **Process rating (provisional)**
 - **Debriefing**
- } Checklist-based

The Rating Dilemma

- Different *rating methods* can be applied
- ranging from the mere processing of measured indicators up to the unaided assessor's judgement
- Need to establish the *requirements* to be satisfied for a rating method to be valid
- Trade-off: assessor's judgement driven by checklists

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Confidentiality Policy

- Care has been taken on convincing the supplier that process assessment does not disclose sensitive information about particular techniques used in software development nor details on proprietary software or algorithms
 - process assessment methods do not need investigation on technical aspects: they only investigate on knowledge, experience, skill, confidence, benefits, resource allocation and management of such aspects.
 - any unwanted leakage of information is covered by the security policy and security process of the assessing team.

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Project implementation post-assessment activities

- Process rating (final)
 - ✓ For each process assessed, assign a rating to each process attribute
 - ✓ Record the set of process attribute ratings as the process profile and calculate the capability level rating
- Reporting the results
 - ✓ Prepare the assessment report
 - ✓ Present the assessment results
 - ✓ Finalize and distribute the assessment report

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Project status

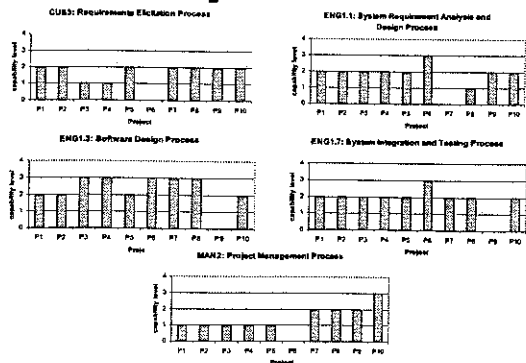
- Seven assessments performed (on 10 projects) so far
- Four more assessments scheduled this year
- Further assessments planned (next year), including re-assessments for improvement verification

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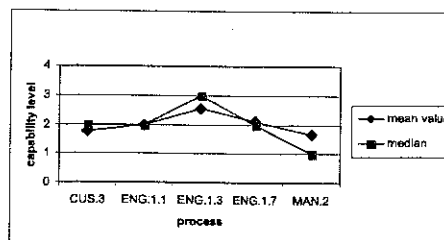
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Project results



Project results (Synthesis)



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Resulting considerations

- The demand for the use of electronics and software solutions has been dramatically growing in the last years and will be even more in the next future.
- The answer is not completely adequate, as it comes from an environment (both customers and suppliers) that is not enough prepared to the transition - for historical, cultural and technical reasons: innovation is often apparent only, actually based on giving old concepts new names.
- From the case study, some trade-offs seem to be crucial to the automotive community and their investigation can provide research topics to help automotive organizations respond to the challenges presented by today's global competitive environment.

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Concluding issues

- Trends
 - Requirement analysis as a key Issue
 - Awareness of the customer role in the acquisition process
 - Need for new SW development models
- Trade-offs
 - Platform-oriented vs customer-oriented
 - Resource (memory size, processor performance, design complexity) saving vs maintainability and reliability
- Open issues
 - Interoperability at subsystem level (ECU)
 - Safety and security implications

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