Certification :
- Origines et importance pour les systèmes informatiques
- Concepts de base et recherches induites

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Overview

- Embedded real-time software systems

1. Statement: Increasing of their responsibilities

2. Requirements: Assurance of absence of risks

3. Solution: Certification

4. Certification for new software technologies

Increasing of their responsibilities

- A. Responsibilities to improve product performance

- Not prone to ageing => implementation reliability

- Ignition of sparks => car reliability

- Flexibility => adaptable behaviours

- Ignition / valve opening control => lowest emission

- Easiness => complex behaviours

- Shock absorber laws => more comfortable

Increasing of their responsibilities

- B. Responsibilities to take charge of bad use of the product

Driving actions => Harms

Software actions -> Harm prevention

Too high speed => Accident

ESP & ABS -> Skid prevention

Increasing of their responsibilities

- C. Responsibilities to take charge of inadequacies of other technologies used in the product

Mechanical part = Ageing => deteriorated states

Software -> acceptable states / detection

Ageing of mechanical techno. => Excessive emission

Software control system -> detection and/or correction

Ex. Gaz recycling (EGR)

Increasing of their responsibilities

- D. Responsibilities to take charge of design faults of other components of the product

Car mechanically unstable at braking time

to prevent harms (skids)

Increasing of their responsibilities

- E. Responsibilities to act & decide

Decision	Action	Example
		ABS
		

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A contradiction

- Embedded software size & complexity increasing
  - => failure risk increasing
- Embedded software responsibility increasing
  - => failure risk acceptability decreasing
- More responsibilities => More guarantees

Requirements for more guarantees

- A justified suspicion
  - Citizens as product users (car failures & recalls)
  - Authorities as citizens require more assurance
  - Engineers as designers: long testing period
  - Firms as producers
    - Harms: trade and financial risks: penalties

Example of harms

- Toyota lawsuits
- September 1998: Court of California:
  - Recall requirement (software fault in an on-board system)
  - 330 000 cars x 250$ > 82 million $
- July 1999: US Department of Justice:
  - Recall of 2.2 million of cars = 250 million $
  - + 58 BILLION $ (civil fine)

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Certification

- A third-party gives written assurance of the conformance
- Conformance to safety requirements: no harms

Certification

- Often considered
  - by engineers as
    - additional constraints
    - a way to judge their activities
  - by firms as
    - overcosts
    - additional issues

Certification

- Whereas it provides
  - for engineers
    - good practices to increase assurance
    - low responsibilities (using the best practices)
  - for firms
    - a trade advantage
    - a partial transfer of responsibilities to certification authorities

Toyota: end of story

- California court: 24 February 2000
  - No recall as Toyota software system complied ARB certification process
- California court settlement: March 2002
  - 7.9 million $ for environmental projects
- Federal court settlement: March 2003
  - 20 million $ for projects to reduce emission
  - 500 000 $ for fine
- To be compared to 250 M$ (recall)+58B$ (fine)

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Certification issues

- Partial transfer of responsibilities to certification authorities
- Potential consequences: New requirements
  - Limitation of software system responsibilities (ex. SIS)
  - Limitation of software system complexity
  - Use only conventional software technologies
  - More assurance requirements: previous + + +
- Example: Object-Oriented design
- Coûts par secteurs : avionique, ferroviaire, ...

Attentes des organismes de certification

- Apporter la garantie de la sécurité/safety
- Sécurité = Absence de risques inacceptables (Guide 51 / ISO)
- Deux questions :
  - Quels risques ?
  - Comment en assurer l'absence ?
- Travaux LESIA :
  - Risques technologiques (UML, Java) + fonctionnels
  - Approche standard (Guide 73 / ISO)

Approche standard : Gestion du risque

- Risk identification (phenomenon, etc.)
  - associated with the technology & its use
  - Harms & Benefits
- Risk estimation
  - Seriousess & probability
- Risk evaluation -> Acceptability
- Risk treatment (reduction)
- Risk communication

Identification : source des dommages

- Quels dommages ? fautes dans modèles ou prog.
- Quels sources ?
- Individu + Phénomène danger. => évt dommag. => Dommage
- Individu + Energie cinétique => choc => Blessure
- Ingénieur + Techno logicielle => erreur humaine => faute

Identification : source des dommages

- Individu + Phénomène danger. => évt dommag. => Dommage
- Ingénieur + construction lang => Erreur compréh. => faute
- Phénoméne dangereux : Héritage
- Situation dangereuse : surcharge par une variable lors d'un héritage
- Evt domm. : Surchage d'une variable ayant un sens différent
- Dommage : accès non autorisé à une variable par une méthode héritée

Identification des sources des dommages

- Java : par la littérature. ex. OOTiA
- UML : Modèle de faute / Norme 2.0

- Etude des bénéfices

Approche standard : Gestion du risque

- Risk identification (phenomenon, etc.)
- Risk estimation <========
  - Seriousess & probability
- Risk evaluation -> Acceptability
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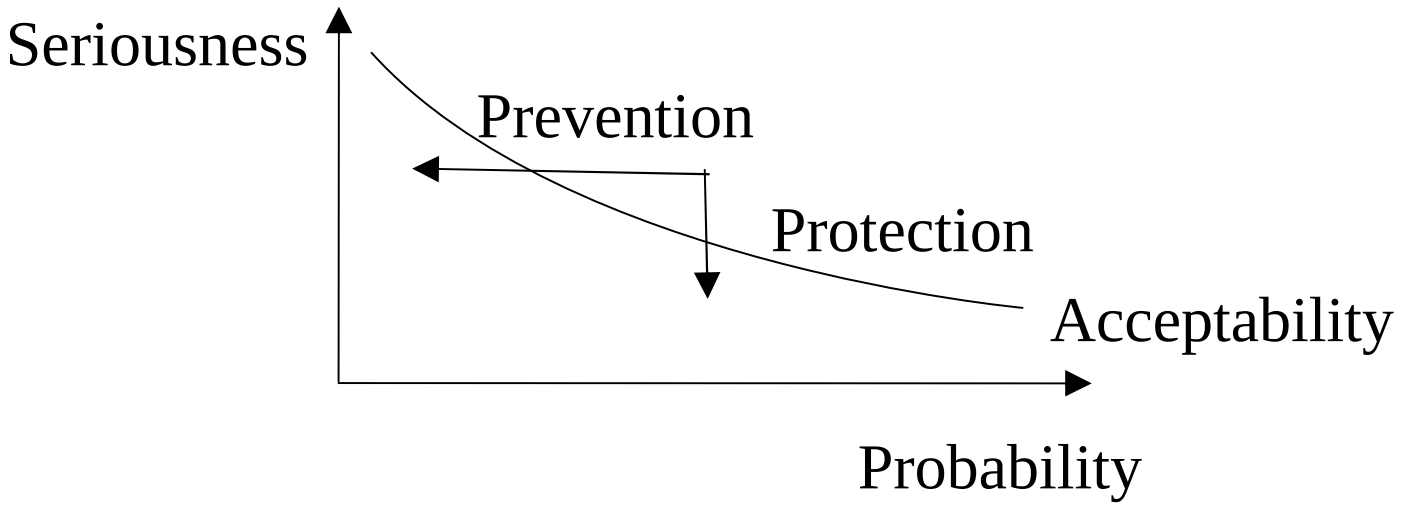
Estimation des risques

- Deux grandeurs :
  - Probabilité des fautes ? (systémique)
  - Gravité : difficulté à détecter
    - ISO 15942 (2000) / Ada

Traitement du risque

- Acceptability (SIL)
- Risk reduction



Traitement des risques

- Individu + Phénom. danger. => évt dommag. => Dommage
- Individu + Energie cinétique => choc => Blessure

- Réduire la probabilité (prévention) :
  - Barrières
- Réduire la gravité :
  - Phénomène : vitesse réduite
  - Dommage : muscles compliants

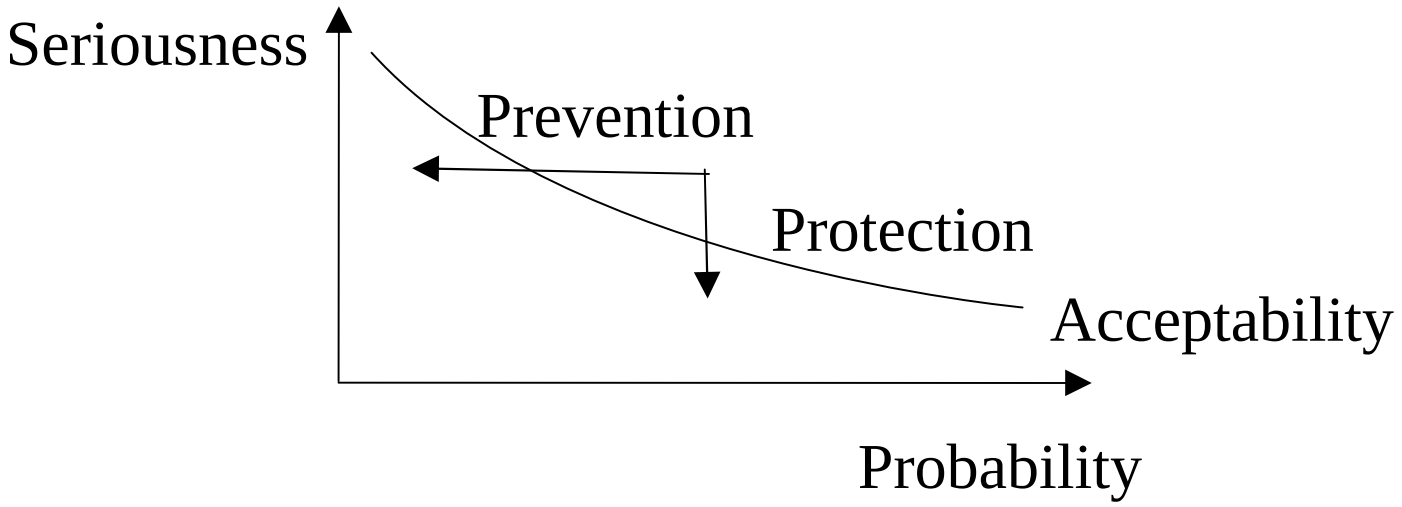
Réduction des risques

- Individu + Phénom. danger. => évt dommag. => Dommage
- Ingénieur + Techno logicielle => erreur humaine => faute

- Phénomène : restriction des constructions ou de leur usage
  - Pour prévenir les fautes
  - Pour faciliter leurs détection
- Evénement dommageable : Guide de style
  - Pour prévenir les fautes
  - Pour faciliter leurs détection

Acceptabilité

- Mettre en avant les bénéfices
- Evaluer le rapport Dommages / Bénéfices



Current studies

- Java technology (language and virtual machine)
  - Thales Avionics
- UML technology
  - Avionics: Airbus, Aonix, Thales + CEAT & CNRT AE
  - Military systems: DGA & ONERA
- Based on a risk management approach (ISO Guide 73) showing
  - Harms & Benefits to safety

Personnes

- Louise TYSK (CIFRE Thales)
- Hugues MALGOUYRES (DGA)
- Jean-Pierre SEUMA VIDAL (MNRT)
- Stéphane LERICHE (Thales Avionics)
- Gilles MOTET (LESIA – INSA)
- + collaborations

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