

Software Requirements and Sustainability

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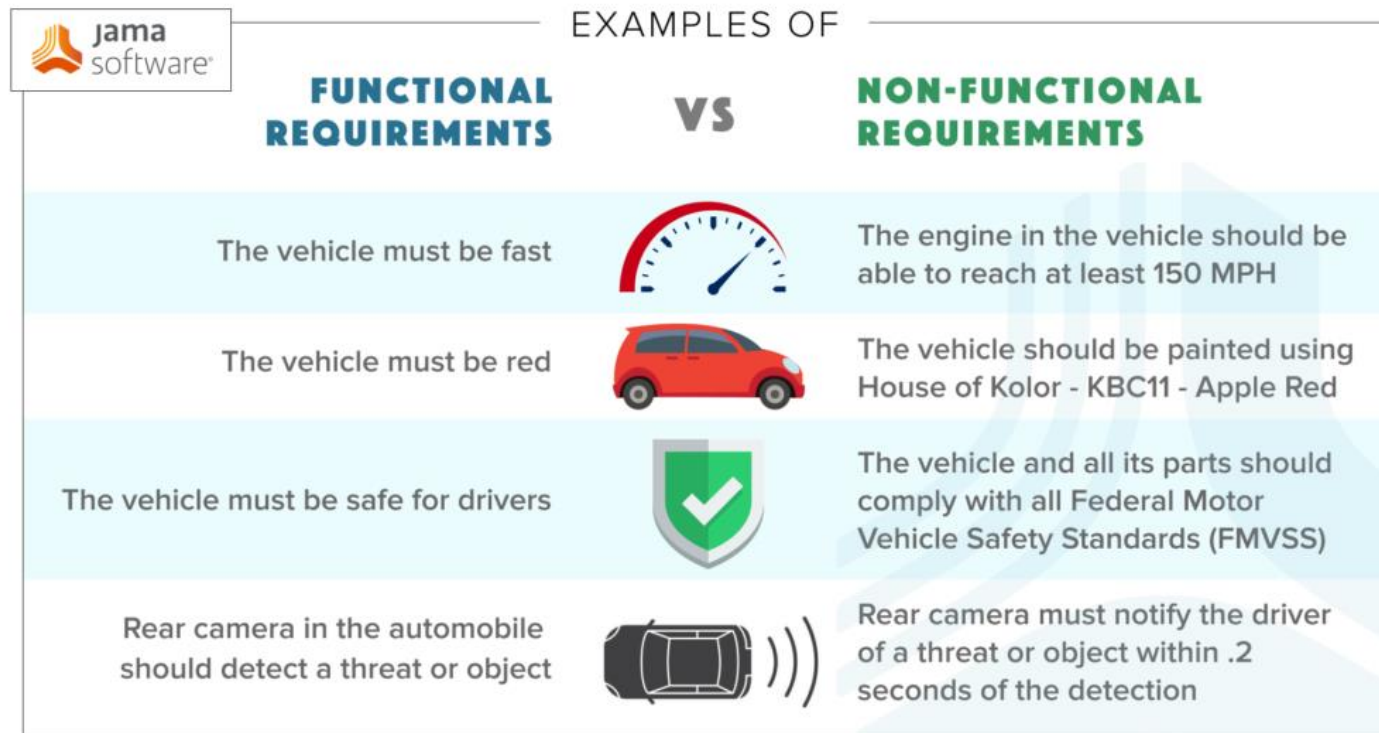
Software Requirements and Sustainability

Functional Requirements:

- Describe what the system should do and are related to user needs.

Non-Functional Requirements:

- Define how the system performs its functions.



Sustainability in Software Systems

Sustainability Dimensions in Software:

- 1. Social:** Impact on society and communities.
Encourage inclusivity and accessibility.
- 2. Environmental:** Reducing negative environmental impacts. Optimize resource use and reduce waste.
- 3. Individual:** Enhance user well-being, satisfaction, user experience and privacy protection.
- 4. Technical:** Long-term adaptability and evolution.
Ensure scalability, maintainability, and resilience.
- 5. Economic:** Balancing financial benefits and costs.
Reduce costs and promote financial efficiency.

Foundation (1): 5 dimensions of sustainability



[GIBSE'13] Birgit Penzenstadler, Henning Femmer
A Generic Model for Sustainability with Process- and Product-specific Instances.
1st Intl. Workshop on Green In Software Engineering, Green By Software Engineering (at AOSD'13)

Gather Requirements with Sustainability Considerations

Identify Stakeholders:

- Include users, developers, sustainability experts, and business analysts.

Use Elicitation Techniques:

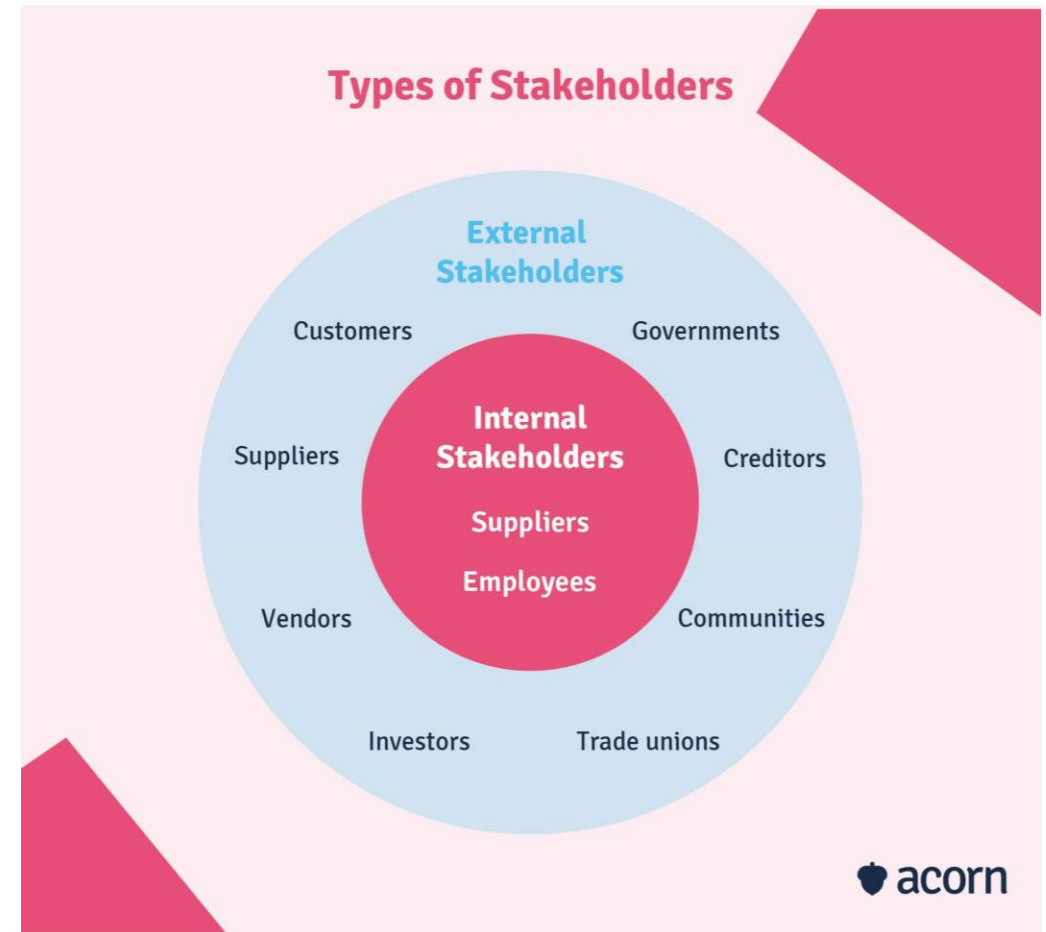
- Surveys, interviews, workshops, observations, and brainstorming sessions that include sustainability questions.

Focus on Sustainability Goals:

- Determine how each requirement can impact social, environmental, technical, and economic sustainability.

Document Requirements:

- Use clear, concise language that captures sustainability goals and ensures traceability and alignment with sustainability.



Writing Requirements with Sustainability Focus

Template for Functional Requirements:

- "The system shall [action] [sustainability impact]."
- **Example:** "The system shall adjust video resolution based on bandwidth to reduce energy usage."

Template for Non-Functional Requirements:

- "The system shall achieve [performance metric] to ensure [sustainability goal]."
- **Example:** "The system shall ensure a minimum of 70% renewable energy use in data centers to reduce environmental impact."

Netflix Case Example

Functional Requirements with Sustainability

Example 1: Energy-Efficient Streaming

- **Requirement:** The system shall dynamically adjust video resolution based on the user's network bandwidth to minimize data usage.
 - **Sustainability Impact:** Reduces energy consumption by decreasing data transmission and processing load.

Example 2: Localized Content for Diverse Audiences

- **Requirement:** The system shall provide content recommendations based on user preferences and region to promote cultural diversity.
 - **Sustainability Impact:** Supports social inclusion by promoting culturally relevant content to diverse audiences.

Example 3: Smart Downloading Feature

- **Requirement:** The system shall allow users to download content in off-peak hours to minimize network congestion.
 - **Sustainability Impact:** Reduces energy usage during peak times by balancing network load.

Functional Requirements with Sustainability

4. Accessibility for Disabled Users

- **Requirement:** The system shall provide audio descriptions and closed captions for all content.
 - **Sustainability Impact:** Enhances social sustainability by improving accessibility for disabled users.

5. Regional Language Support

- **Requirement:** The system shall provide content in at least three local languages for each supported region.
 - **Sustainability Impact:** Supports social inclusivity by providing access to diverse populations.

6. Renewable Energy Usage Tracking

- **Requirement:** The system shall provide analytics to track energy consumption from renewable sources for each streaming session.
 - **Sustainability Impact:** Encourages transparency and supports green energy adoption.

7. Eco-Friendly Content Recommendations

- **Requirement:** The system shall recommend low-resolution content in areas with limited bandwidth to minimize data consumption.
 - **Sustainability Impact:** Reduces data transmission, saving bandwidth and energy.

Non-Functional Requirements with Sustainability

Example 1: Green Data Centers

- **Requirement:** The system shall run on data centers powered by at least 70% renewable energy sources.
 - **Sustainability Impact:** Minimizes the carbon footprint of Netflix's operations.

Example 2: Privacy-Conscious Personalization

- **Requirement:** The system shall provide personalized content recommendations without storing unnecessary sensitive personal data.
 - **Sustainability Impact:** Protects individual privacy while improving user trust and satisfaction, contributing to long-term user retention.

3. High-Performance Scalability

- **Requirement:** The system shall be scalable to handle a 30% increase in users without significant energy cost increases.
 - **Sustainability Impact:** Ensures long-term efficiency as the user base grows.

Non-Functional Requirements with Sustainability

4. Low Carbon Footprint Infrastructure

- **Requirement:** The system shall ensure a 25% reduction in carbon emissions from cloud infrastructure by 2025.
 - **Sustainability Impact:** Promotes environmental sustainability by reducing the environmental footprint.

5. Support for Older Devices

- **Requirement:** The system shall support video streaming on devices manufactured within the last 10 years.
 - **Sustainability Impact:** Extends the life cycle of older devices, reducing electronic waste.

6. Energy-Efficient User Interface

- **Requirement:** The system shall provide a dark mode option to reduce energy consumption on OLED displays.
 - **Sustainability Impact:** Reduces energy usage by lowering the power needed for display lighting.

Best Practices for Gathering Requirements with Sustainability Consideration

- **Engage Diverse Stakeholders:** Include sustainability experts, users, and developers in the process.
- **Quantify Sustainability Goals:** Set measurable objectives, like reducing energy consumption by 20% or reduce carbon emissions by 25%.
- **Monitor and Adapt:** Continuously assess and update sustainability goals based on changing needs, technology advances and and market trends.
- **Prioritize Sustainability Early:** Address sustainability from the start of the project to ensure alignment with development goals.

Questions?