Ariane 5: Who Dunnit? Report

F28SD

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D1

Ariane 5 is a European heavy-lift space launch vehicle. It is developed and operated by ArianeSpace for the European Space Agency. It has been used to deliver payloads into geostationary transfer orbit or low earth orbits. On 4 June 1996, the maiden flight of Ariane 5 exploded 37 seconds after liftoff.

D2

The programmers said that a 64-bit floating point was converted to a 16-bit floating point. This made the value of the floating-point number that was converted to be larger than what the 16-bit could represent, causing an operand error which could not be anticipated by the code.

The system designers said that the system only accounted for random hardware failures. The system was unable to recover from a random software failure, causing both the main and backup processor to shut down.

The requirements engineers said that a piece of rouge alignment code that caused the failure existed, which remained operational even though it had no traceable requirement.

The test engineers said that inadequate testing, validation, and verification resulted in the failure, which could have been avoided by proper testing.

The project managers said that with clear-cut authority and responsibility, the failures could have been easily exposed.

D3

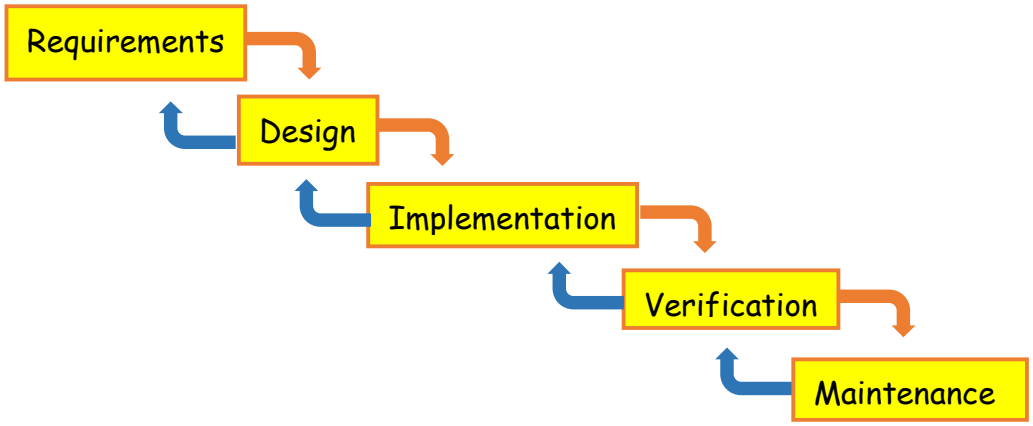
Bashar Nuseibeh states that all the above interpretations are correct, but also adds inadequate risk management as a reason. Risk management was performed at the beginning of the project but as the requirements changed later on, the risks changed, and the decisions taken previously proved invalid.

D4

The sequential process model is a sequence of well-defined phases that each contain fixed milestones. After completing each phase correctly, we move on to the next phase. This process model emphasizes on documentation.

The strengths of this process is that it is well defined and documented, and time is spent early on to fix any bugs. Limitations of this process is that the design and implementation phase inform the requirements phase of any bugs, which would require extensive backtracking. This mode typically makes use of waterfall process, which is used to receive feedback between phases.

Below is a diagrammatical representation of the sequential process model.



The Ariane 5 bug could have been identified using the sequential process model.

The rogue piece of code could have been identified easily by the requirements engineers in the first phase itself since this code satisfied no requirements.

The programming team could have identified the incorrect data conversion in the implementation phase, thereby avoiding the incorrect data conversion.

The system designers could have also accounted for software failures in the design and implementation phase, preventing the main and backup processors from shutting down.

The test engineers could have implemented more tests in the maintenance phase and could have solved any errors in the verification phase.