

**SWENET Module**  
**Ariane 5 Case Analysis**  
**Exercise Booklet**

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# Exercise: Ariane 5 Case Analysis

## Exercise Description

The exercise involves reading about the Ariane 5 accident and using the *Software Engineering Code of Ethics and Professional Practice* [ACM 1999] to study and analyze the the ethical and professional implications of the Ariance 5 software development and deployment.

## Exercise Objectives

Students completing this exercise will be able to:

- \* Analyze the professional and ethical issues related to the Arianae 5 accident [ESA 1996].

## Reading Assignment

Read the following papers:

- \* [ACM 1999] ACM/IEEE-CS Joint Task Force on Software Engineering Ethics and Professional Practices, *Software Engineering Code of Ethics and Professional Practice* (Version 5.2), 1999.
- \* [ESA 1996] Ariane 5 Inquiry Board, *Flight 501 Failure Report*, European Space Agency, July 19, 1996.
- \* [Gleick 1996] Gleick, James, A Bug and a Crash, *New York Times Magazine*, December1, 1996.
- \* [Jezequel 1997] Jezequel , J. and Meyer, B., Design by Contract: The Lessons of Ariane, *Computer*, January 1997.

## Assignment

Analyze and answer the questions in the attached exercise worksheet.

## Exercise Deliverable

- \* Completed Ariane 5 worksheet.

## Ariane 5 Case Analysis Questions

Names \_\_\_\_\_

Using the Ariane 5 documents [ESA 1996, Jezequel 1997], the SE Code [ACM 1999] and any other sources available, answer the below questions:

	<b>Question</b>	<b>Response</b>
1.	What software error did the Inquiry Board [ESA 1996] claim caused the Ariane 5 accident?	
2.	In your opinion, were the Inquiry Board's conclusions about the software error adequately supported in their report?	
3.	The Inquiry Board report states the software module, which contained the error, "computes meaningful results only before lift-off". Why did the flight control system use the results after lift-off?	
4.	What does it mean to say that a variable was left "unprotected"? Why was the BH variable left unprotected?	
5.	The report claims that there was a culture inside the Ariane program of only addressing random hardware failures. How did such a "culture" contribute to the Ariane 5 accident?	
6.	The report states "There is reason for concern that a software exception should be allowed, or even required, to cause a processor to halt while handling mission-critical equipment". Do you think the inquiry board should have been concerned? Is such a concern covered by the SE Code? If so, what part?	
7.	The report states that the Ariane 5 program seemed to have the view that "software should be considered correct until it is shown to be at fault". What do you think? Is this an issue of legitimate technical dispute or is it a problem of professional conduct? Does the SE code apply here?	
8.	How did the Ariane 5 accident relate to good software engineering practice? See 8a, 8b, 8c, 8d, and 8e below.	
8a	<b>Requirements</b>	

	Were there root causes for the accident due requirements engineering problems? If so, what were they? Is this an SE Code problem?	
8b	<p><b>Design</b></p> <p>In [Jezequel 1997], the authors claim that if a “design by contract” methodology and a language like Eiffel had been used, the accident would probably have been prevented. What do you think?</p>	
8c	<p><b>Programming</b></p> <p>In [Jezequel 1997], the authors give an example of Eiffel code that they would accommodate the requirement that “the horizontal bias should fit on 16 bits”. Will the Eiffel “require” code do the job?</p>	
8d	<p><b>Test</b></p> <p>Why wasn’t the error discovered during testing? Were the explanations provided reasonable? Does the SE Code apply here?</p>	
8e	<p><b>Other</b></p> <p>Are there other areas of software engineering practice where there were problems?</p>	
9	With reference to ABET’s Criterion 4 (Professional Component), do you see any problems in the Ariane 5 software development as related to the following considerations: economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political?	
10	How would your response to question 9 change, if the Ariane 5 was a toy rocket rather than a satellite delivery system.? What if the Ariane 5 was a missile weapons system?	