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FOR ENGINEERING AND SCIENCE

Let the Chips Fall Where They May

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Description

A chip designed for a new scientific calculator allows it to display and calculate to the 17th significant digit. It is discovered, however, that the new calculator is inaccurate beyond the 13th significant digit. The company is deciding between several solutions, some of which raise ethical concerns.

Body

Introduction

A Buffalo Computing Co.(ABC2) located in Fargo, ND, has designed a chip for a new scientific calculator that features high-precision floating-point accuracy to 17 significant digits for all 250 mathematical functions provided with the unit. After one-and-a-half years in development, and after shipping over 500 (or 5,000) beta units to key customers, the company discovers that there is a problem with certain calculations, as described below.

In order to expedite floating-point(ft.-pt.) operations (used in handling scientific notation in mathematical operations) in a computer or calculator, often certain tables of values are used to assist in the speed of execution of these ft.-pt. operations. (For example, a calculator requiring as long as 3 minutes to perform a tangent calculation would have no market appeal.) These tables can contain up to 100 integer entries. During beta testing, ABC2 discovers that several of these values were incorrectly entered before burning them into the firmware. Further testing concludes that because of the location and use of these table errors, the only mathematical results affected will occur in the 13th to the 17th significant digits for the double-precision fl.-pt. operations.

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Numerical and Design Problems

1. As the senior engineer on this project for ABC2, you are asked to propose a resolution for this situation. How serious is the problem? What should be done?
2. Call together a committee of your peers and have the group propose as many different alternative solutions as you can think of within 10-15 minutes. (Do not assign any value or determine the implications of this proposed solution for now--instead, use the blue-sky or "popcorn" approach.)
3. Now, try to project each option's impact on the company.
4. Assign a weighted value (0-100 with 100 as best) to each of the suggestions and resulting actions proposed above, based on your personal assessment or your peer group's assessment of the quality of the action.
5. Determine the best possible course of action and explain the reasons for your choice, based on the weightings given above or other criteria you create and document.

6. Write this up in a detailed memo with explanations (2-3 pages), or imagine yourself the senior engineer on the project and write a detailed dialogue with the senior manager(s) deciding what action(s) to take.

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Questions on Ethics and Professionalism

1. Are your answers to the above questions the same regardless of whom you represent? In other words, does one's response change depending on one's stake in the solution? (e.g. company managers, stockholders, engineers in the firm, engineers hoping to use the chip, purchasers of the product, etc.)
2. Suppose the chip has been installed, 100,000 units have been sold, and an additional 50,000 are on dealers' shelves. Create a new list of possible actions and reactions.
3. Do you see any relationship to the *Challenger* decision(s)?

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Proposed solution to the ethical issues raised

Possible Suggestions to Q #2:

1. Cancel the project.
2. Change the display to 13 digits.
3. Redesign the chip.
4. Since the problem will only occur infrequently, simply ignore it. Is this dangerous or risky? Why?
5. As it will only occur every 20,000 years to the typical user, no one should be concerned.
6. Suggest an advertising slogan with a buffalo logo of "Our chip is a lot of bull!"

Possible Implications in Q #3:

1. Since ABC2 is "staking" their future on this Buffalo chip, this could destroy the company.
2. This can be done, but it makes the unit far less competitive, and is not consistent with specifications or with advertising claims.
3. This solution will cause a year delay and the competitive edge will be lost.
4. Who really are the affected users? Won't this result in a significant liability for any errors which occur?
5. Funny, but probably fatal to the company!

NOTE: This list can go on and on with follow-up detailed, subsequent decisions and scenarios, many of them based (loosely) on the Intel Pentium chip case.

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Appendices, Attachments, and Bibliography

- *Computer Organization and Design: The Hardware/Software Interface.* Hennessey and Patterson, Morgan Kaulmann Publishers, 1994.
- Assistance in developing and understanding this issue was provided by Sarn Figueroa, formerly a professor at Taylor University and now with Next Computing. This incident is NOT based on any known situation at Next Computing.

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Notes

These problems were originally developed as part of an NSF-funded project to create numerical problems that raise ethical issues for use in engineering and other course assignments. The problems presented here have been edited slightly for clarity.

Rights

Resource Type

Case Study / Scenario

Parent Collection

Numerical & Design Problems With Ethical Content

Topics

Product Liability
Public Health and Safety

Discipline(s)

Computer Engineering
Authoring Institution
Zachry Department of Civil Engineering-TAMU Ethics