

# **Embedded Software Development Issues and Challenges**

**Failure Is NOT An Option -  
It Comes Bundled With The Software**

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## Overview

Very soon hundreds of embedded vendors will bring their wares to Boston and the 2003 Fall Embedded Systems Conference. At not insignificant expense, they will offer solutions to the groups of embedded developers that they believe constitute their core market – and they will exchange information and explore potential alliances with other vendors that will also have a perception of certain embedded market segments that represents new and expanded business. Moreover, they will buy booth space and attend other conferences later in the year. With the apparent return of the technology economy, they will be bringing along a contingent of sales, marketing and executive staff.

Some vendors will generate sufficient interest and leads that will make very successful, their attendance at the conference. Some will fall short of their goal. Fewer yet will know whether they optimized their opportunity.

As a former entrepreneur/CEO who has learned painfully (and financially) the importance of quality market intelligence and strategic insights, it continues to be a personal source of subdued amusement to see how much money and resources vendors throw at retaining current customers and attracting new customers through advertisement and conference attendance, while spending precious little on identifying and addressing markets that are either growing, collapsing, or in transition and open to new solutions. Market research budgets in electronics and information technology are substantial because vendors in those highly competitive markets understand the need for gaining a competitive edge. Many vendors that compete in the embedded marketplace, which is more competitive and at greater risk to upheavals than in the electronics or IT marketplaces, have yet to recognize the importance of market intelligence in their organization.

## Market Intelligence

Embedded Market Forecasters (EMF) has produced in-depth research and a detailed reporting of the embedded marketplace. This research has included a comprehensive investigation into the mindsets and the activities of embedded developers, including:

- Design starts, completions, cancellations, and outsourcing as reported by 10 specific vertical markets, microprocessor design architecture (including DSP and FPGAs) and microprocessor family used
- Current stage of design development, host platforms used, specific MPU/MCU used, target OS selected, and allocation of total design development time
- Development tools used (and expected to be used in the next 12 month period) and programming languages employed, including attitudes toward Java and Linux

- Important considerations in the decision to purchase a specific tool and the attributes most important in the selection of a vendor – and the job title of the person most influential in recommending a purchase and the individual responsible for making the purchase.
- Compilers, debuggers, device drivers, hardware, software and co-development tools, and simulation-modeling tools used in the embedded design process

This 2003 database of 947 embedded developers that responded to specific questions regarding their activities, preferences, design problems encountered, etc., were cross tabulated into a single sheet such that the response to each question could be examined according to the responding engineer (hardware, software, systems, firmware, manager), and 10 specific vertical markets for which the reported design was intended. A second sheet was prepared such that the responses could be viewed from the perspective of developers using 8-bit, 16-bit, 32-bit, 64-bit, DSP and FPGA architectures, as well as from 6 different microprocessor families (Motorola, Intel, etc.).

EMF, based upon the large and detailed survey response, is in a unique position to address the principal issues confronting (and expressed by) embedded developers. EMF believes that this information can be of importance to embedded vendors.

The following data shed light on the design process and the hidden costs of development delays and cancellations. By comparison, the cost of expensive development tools may be a real bargain when compared to the months of engineering time wasted by delays and cancellations. The data presented represents the total response. These data are also available according to engineering title, application vertical market, microprocessor architecture and microprocessor family.

- |                               |              |
|-------------------------------|--------------|
| ▪ Design starts               | 45000        |
| ▪ Design cancellations        | 13.1%        |
| ▪ Time before cancellation    | 4.6 (months) |
| ▪ Completed ahead of schedule | 15.50%       |
| ▪ Completed behind schedule   | 54.0%        |
| ▪ Avg. delay in completion    | 3.9 (months) |
| ▪ Designs outsourced          | 11.6%        |

Perhaps most shocking from a market intelligence point-of-view is the response of embedded developers to a basic and simple question – how close to your pre-design expectations was your final design based upon performance, systems functionality, features and schedule? The answer to this question clearly highlights the most significant problem confronting embedded developers – and a significant opportunity to embedded vendors. Developers were given the following options for each category:

- |              |                  |
|--------------|------------------|
| ▪ Within 10% | ▪ Within 40%     |
| ▪ Within 20% | ▪ Within 50%     |
| ▪ Within 30% | ▪ Not within 50% |

## **Performance**

- 31.7% of designs were within 10% of pre-design expectation
- 19.3% of designs were between 10%-20% of pre-design expectation
- 40.3% were not within 30% of pre-design expectation
- 31.3% were not within 50% of pre-design expectation

## **Systems functionality**

- 39% of designs were within 10% of pre-design expectation
- 14% of designs were between 10%-20% of pre-design expectation
- 40.5% were not within 30% of pre-design expectation
- 32.8% were not within 50% of pre-design expectation

## **Features and schedule**

- 19.8% of designs were within 10% of pre-design expectation
- 18.6% of designs were between 10%-20% of pre-design expectation
- 57.8% were not within 30% of pre-design expectation
- 26.6% were not within 50% of pre-design expectation

The failure of designs to approximate pre-design expectations is clearly unacceptable and the problem is destined to become worse as design complexity increases. Developers indicated that when results failed to meet acceptable approximations to expectations that, in order of response, schedules were slipped, minor software modules rewritten and features removed.

Embedded developers were asked to identify the biggest problems they confront in hardware-software integration. Fifteen suggested answers were presented (plus “other”) and the respondent was limited to selecting 4 responses. This provided a preferential ranking by order of importance. The following items were the most frequently selected problems.

- Limited Visibility into the Complete System (65%)
- Limited Ability to Trace (54%)
- Limited Ability to Control Execution (42%)
- Significant Intrusiveness Into the System (40%)

## Final word

It is clear from the information provided herein that embedded software practices, being much less methodological than hardware design processes, are responsible for design delays and missed “windows of opportunity”.

Embedded vendors will find solutions for these problems. EMF believes that those vendors that wish to remain with the status quo will find their market share eroded as better solutions replace current offerings.

Embedded developers are becoming acutely aware of the associated costs of design delays, the cost of delays in making the cancellation decision and the failure of final design results to approximate pre-design expectations. Already simulation-modeling and co-development tools (among other solutions) are gaining momentum in addressing these issues, putting at risk other vendors’ products that fail to address the problem.

*Embedded Market Forecasters is the embedded market research division of American Technology International, Inc. Dr. Krasner is the EMF director.*