A Critical Evaluation Of:

"THE EFFECT OF ACCELERATION TECHNIQUES ON PRODUCT

DEVELOPMENT TIME"

By B.J. Zirger and Janet L. Hartley

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Prepared for:

Professor Dundar F. Kocaoglu

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Prepared by:

Scott Beers

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1.   Introduction & Background

The paper attempts to empirically study the effects of the application of selected engineering management technologies on the length of product development time. The goal is to find out if these techniques are at all effective in shortening product development time. Several technologies were studied as possible methods of reducing product development cycle time. Three main areas of application were identified: product strategy, development process, and the development team structure. These areas are broken down below:

Product Strategy	Choosing a product strategy that minimizes the amount of product and process change
Incremental Product Change	Making frequent, incremental changes rather than longer, more radical product changes (evolution vs. revolution).
Part Reduction	Using fewer parts in a product relative to previous versions.

Product Development Processes

Overlapping Development Processes	Overlapping of development activities traditionally done sequentially, such as the overlapping of product design, process design (also known as concurrent engineering).
Freezing the Product Design Early	Limiting the number of voluntary design changes that occur late in the development process by freezing the product design early.
Supplier Management	Reducing the number of suppliers, and actively involving the remaining suppliers early in the development process.

Development Team Structure	Altering the development teams composition and structure.
Cross Functional Development Teams	Using a team consisting of members representing all the key functional groups, especially marketing, engineering and manufacturing.
Dedicated Team Members	Team members who share their time with no other projects.
Co-Location	Locating project members physically close together to facilitate communication and decision making.
Decision Making Authority	Giving the team the responsibility and authority to make and implement its own decisions rather than waiting for senior management's approval.
Increased Management Support	Increasing the level of senior management suport for the team decreases development time.
Setting Time As A Goal	Setting and manageing development process time as a specific goal.

1.1 Research Methodology

The researchers used a survey of historical data and performed a statistical analysis using regression techniques. The sample for the survey was the entire list of participants in an upcoming two week summer education seminar. The survey respondents were all general managers of electronics manufacturing firms. Of the 120 potential respondents, 44 useable surveys were generated. The survey had 29 questions. The survey asked respondents to rate their companies performance in terms of the above factors on a recently developed product of their choice. The rankings were codified in a variety of subjective ways. Including five point Likert-like scales. If the respondent had insufficient knowledge to complete the questionnaire, they were encourage to seek out others in their firm with the appropriate knowledge.

1.2 Contribution of the Paper to the Literature

In the words of the researchers the contribution to the literature was twofold:

1) … this study makes a valuable and unique contribution because it represents one of the larger multivariate, empirical study of case study factors purpoted to affect product development time performance

2) … this research is the broadest-based empirical study of product development techniques that has been reported in the literature.

Comments about the paper's contribution come later in this evaluation.

2. Comparison of This Paper to Other Publications In The Field

The following table summarizes the research uncovered as it relates to the research topic and findings reviewed in this paper.

Legend   **S** - Research that supports the primary (Zirger/Hartley) research

E - Research that extends the primary (Zirger/Hartley) research

R - Research that refutes the primary (Zirger/Hartley) research

Product Devel. Time Acceleration Technique	This Papers Findings	Other Research Findings
Product Strategy		
Incremental Product Change	No significant relationship between this technique and faster product development times.	**E** - If companies want to reduce product generation Time-To-Market, development costs and production costs, then Design for Manufacturing and Assembly needs to be integrated into a Product Generation Framework. Concurrent Engineering, Concurrent Mfg., Product Data Management and Predictive Engineering all are essential elements. [1]
Part Reduction	No significant relationship between this technique and faster product development times.	See Above Cell

Product Devel. Time Acceleration Technique	This Papers Findings	Other Research Findings
Product Development Processes		
Overlapping Development Processes	Significantly related to faster product development times.	**S, E** - A serial compression strategy of supplier involvement and overlapping development only describes a faster pace in mature industries. [4]

Supplier Management	Negatively correlated to faster product development times.	**R** - By adopting a more strategic approach to working with suppliers, leading corporations in a variety of major industries have reduced total annual expenditures by an average of 12 percent between 1992 and 1995, an A.T. Kearney study found. The improvements in product development time were equally impressive. Leading companies reduced that time by an average of 62 percent, to just over a year. Most companies expect to shorten the development cycle even more over the next few years. [2]
		E, R - A Research project begun at Michigan State University in January 1995, encompasses twenty months of in-depth study focusing on successful strategies and practices for integrating suppliers into new product development. The research will determine, in a structured fashion: (1) what variables directly and indirectly relate to successful supplier integration into new product development; (2) which strategies and practices work best in achieving supplier integration resulting in competitive improvements; and (3) the circumstances or environments in which the strategies and practices work best. Most importantly, the research will attempt to develop integrative models and implementation roadmaps for putting the strategies and practices to work.
		Preliminary results indicate that companies believe supplier integration is essential to developing new, competitive products. Integration generally occurs through the use of cross-functional teams and formal or informal processes involving suppliers in design and target cost analysis. Most respondents believe that suppliers should be involved in the earliest stages of new product development to leverage supplier strengths. It appears that integration of suppliers will require increasingly formal processes to decide, at program and product levels, when to engage and select suppliers and when to establish accountabilities and performance indicators. [3

Product Devel. Time Acceleration Technique	This Papers Findings	Other Research Findings
Development Team Structure		
Cross Functional Development Teams	Significantly related to faster product development times.	**S, E** - A Stanford research project found that using an experiential strategy of multiple design iterations, extensive testing, frequent project milestones, a powerful project leader, and a multifunctional team accelerates product development. [4]

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3. Strengths and Weaknesses of This Research

3.1 Concepts

The concepts of the research seem sound enough even if the premise they are founded on goes wholly untreated in the research. This premise is that bringing new products to market as fast as possible is a strategic imperative in many markets, especially in high technology markets. Hence shortening the product development time is one way to shorten time to market for products. Therefore everyone will want to shorten product development time to help them become first to market. This last part is true for some, maybe even most companies, but certainly is not uniformly true. Some firms have made strategic decisions to <u>not</u> be first to market. This strategic filter would almost certainly affect how the respondent's company employs the surveyed techniques. This filter does not appear to be acknowledged in this research, and hence may affect the validity of the survey data. There is even research to indicate that firms who are first to market are not necessarily those that remain for the long haul. Research has found that in only 11% of the markets surveyed were the current leaders also first to market. [5]

3.2 Methodology

The researchers state,

> "While rich in description and practical examples, most of the literature discussing product development cycle time is based on managerial experience or small sample case studies. However, no systematic empirical studies have identified which, if any of these techniques, differentiate the fastest products from the slowest. The purpose of this paper is to identify whether use of the most commonly prescribed product development acceleration techniques is related to fast product development ."

It seems to me that the researchers study is simply a sum of management experience from their sample set. That the data was collected in an organized form from a questionnaire does not excuse the fact that there was little or no way to verify the accuracy of the data.

The methodology has, in my view, many problems associated with it.

Sample Set was Non-Random

The sample was anything but random. They were a selected group of management individuals who had in common their attendance at a two week management seminar. The topic of the seminar was never discussed, but may certainly have had an impact on characteristics of the sample set. A seminar/roundtable on "Best Practices in Concurrent Engineering" would probably draw a different crowd than "Revitalizing Your New Product Development Process" The first implies those experienced with a specific subset of the techniques studied here, the second describes a set that may be first timers, or those having problems revitalizing their new product development process. We may be looking at the best, or the worst, or the average in their field, but it's certainly not random.

Product Chosen Was Not Random

We do not know why the executive chose the product they did for evaluation. Did it represent their best effort or their worst? We have no way of knowing as we did not see the instructions, however surely, this is significant.

Respondents Qualifications Unverified

The respondents are asked to fill out all the questions they can and then seek the help of others in the firm if necessary. What percentage of the respondents sought help? On what questions? Was there a pattern? If the respondents answered all the questions themselves, how much time did they spend. If they came to a question they couldn't answer, did they "wing it" in the interest of time, or did they dig out the data or the people who had the answers?

No Verification Responses Within a Company

The data is both historical and subjective. We have no way of knowing if a respondents survey results represent the generally accepted opinion within the company, or something else. A sampling and analysis of multiple respondents within the same firm would help to validate that firms response. The model does not address this.

Inconclusiveness of Industry Time To Market

If I say my competitor is twice as fast to market as I am, does that mean that of the techniques I use, he uses them better, or does he use different ones? Or is it my firms strategic decision to never be first to market, preferring to lay back and see where the market develops, leaving the risk of market innovation to others. These are important questions that if included in the research may significantly affect the results.

Product Strategy - Number of Parts

Often, decreasing the number of parts means increasing the complexity of the remaining parts. These parts are more complex to design, manufacture , and more costly to service. This was not addressed in the research [ ].

Teams

We have no data about the team type, composition, availability of team tools or training levels, much less any way to correlate the responder's sample set. We do know that the respondents, (management) rated management support as high for their development project. It seems there is the opportunity for bias here.

3.3 Results

My powers of statistical analysis are very rusty, but the following are problems I observed from the analysis of the results:

Poor Approach

A historical survey technique, followed by regression analysis is very weak. We have very little knowledge of the circumstances under which the data was provided.

Autocorrelation

There is a problem with including variables with high correlation in the model. "Number of Functions", "Dedicated Team", and "Management Support" all had high correlation. Removing the effects of autocorrelation from the model would have the effect of lowering the r value, and thus lowering the amount of variance that could be accounted for. [6]

Inference Space

This survey was of a selection of electronics manufacturers. With the number of potentially detracting factors revealed thus far that were not addressed in the research, the inference space may be limited to just these companies, or a subset of these companies. Either of which limits the usefulness of the research [7]

4. Conclusions of This Research

Of the twelve techniques measured, only four were significantly related with faster product development times:

1) Number of functions represented on the team
2) Dedicated team members
3) Time as a goal
4) Overlapping development activities

There were two factors reported as having a negative correlation:

1) Reducing the number of major suppliers
2) High level of management involvement

The researchers do an acceptable job of explaining why these items are important to fast product development times, but they are really just echoing the body of literature. There are no new insights.

The researchers concluded that, given many of the techniques were not supported that successful fast cycle development can not be accomplished by using a sporadic combination of factors. Further, they felt that additional research was needed to explore the interaction and mediating effects of the techniques on each other, as well as to identify other intermediate processes and external conditions that may also effect product development effectiveness.

I found the latter half of this conclusion unacceptable and unsupported by their research. There was nothing in the research to indicate that the respondents were instituting the techniques in a "sporadic" way. In fact there were no questions at all about the strategic implications of why a firm had selected to implement the set of technique they had, or whether a firm was even focused on being first to market. Furthermore, the researchers gather no historical data to indicate the relative level of experience each of these firms had with these techniques, what investments in training and analysis they had made, or how these figures might compare with the rest of the industry.

As in with any technique or technology how you use it is at least as important as the technology itself. We have no data on the level of experience these firms have with any of the techniques they used. We don't know how they were implemented, or how carefully there requirements and results are feed back into the process. Dismissing a technique on the basis of this research would be completely unfounded, as the methodology simply does not provide enough of, or the right kind of data to support any model.

5. Related References

There are a variety of other tools that are associated with the reduction of product development time that were not studied by the researchers.

Engineering Tools
    CAD/CAM/CIM/CAE [8]
    Rapid Prototyping [9]

Decision Support Tools
    Quality Function Deployment [10]

Quality Management [11]

Additional Group/Team Techniques
    Customer Input to Design Process [12]

Information Systems Tools
    Groupware [13]

As one can see, there is a rich body of research within the scope of "Accelerating Product Development Time" that was not covered by the research. It would be a mistake to consider only those techniques evaluated by the researchers as worthy of consideration.

6. Areas of Further Research

There is a large amount of data that needs to be collected and analyzed before a study like this is useful. First it seems important to separate the firms who use these techniques for being first to market, vs. firms that use these techniques for other purposes (cost savings, quality improvements, etc.). Once a suitable sample set is selected, a more statistically accurate method of determining mean and shortest time to market can be determined (e.g. 3-sigma). After these benchmarks are established, one can begin to examine the techniques used by the "best and the rest". My suspicion is that you'll see that how a technique is implemented is far more important than what technique is implemented. Re-engineering has posted some impressive wins, yet estimates of industry-wide re-engineering failures range as

high as 70%. The most minimal improvement properly executed is often better than the most dramatic methods poorly implemented.

7. Bibliography

1 Holden, Happy, "The Challenge:To Find A Framework And Vision From Which To Launch Dfm/A", *A Hewlett-Packard Corporation Publication*, 1994

2 Dow, Janet, "Companies Gain Competitive Edge, Slash Costs, Cut Product Development Time By Strategic Sourcing" *A.T. Kearney Study*, April 22, 1996

3 Monczka, Robert M., "Supplier Integration into New Product Development", *NSF Study, University of Michigan,* January, 1995

4 Eisenhardt, Kathleen and Tabrizi, Behnam, " Accelrating Adaptive Processes, Product Innovation in the Global Computer Industry", *Administrative Science Quarterly*, pp 84-110, March, 1995

5 Anon., "Why first may not be last", *Economist*, pp. 65, Vol 338, Mar 16, 1996

6 Box, George, et al., "Statistics for Experimenters: An Introduction to Design, Data Analysis, and Model Building", *John Wiley & Sons*, USA, 1978

7 Lorenzen, Thomas J., Anderson, Virgil L., "Design of Experiments: A No-Name Approach", *Marcel Dekker, Inc.*, USA, 1993

8 Studt, Tim, "CAD systems get even smarter, speed up product development", *R&D*, pp. 25-27, April, 1995

9 Ashley, Steven, "Rapid prototyping is coming of age", *Mechanical Engineering*, pp. 63-68, July, 1995

10 Wernle, Bradford, "How Chrysler builds on the 20% solution", *Automotive Marketing*, pp S-7, Sep, 1996

11 Studt, Tim, "Company's total quality program speeds up product development", *R&D*, p 30, Jan, 1995

12 Datar, Srikant, et al., "New Product Development Structures: The Effect of Customer Overload on Post-Concept Time To Market", *Elsevier Science*, 1996

13 Hise, Phaedra, "From notes to market in no time", *Inc.*, p.108, Feb, 1996