

The CHAOS Report

*"The Roman bridges of antiquity were very inefficient structures.
By modern standards, they used too much stone,
and as a result, far too much labor to build.
Over the years we have learned to build bridges more efficiently,
using fewer materials and less labor to perform the same task."*

-- Tom Clancy (The Sum of All Fears)

Introduction

In 1986, Alfred Spector, president of Transarc Corporation, co-authored a paper comparing bridge building to software development. The premise: Bridges are normally built on-time, on-budget, and do not fall down. On the other hand, software never comes in on-time or on-budget. In addition, it always breaks down. (Nevertheless, bridge building did not always have such a stellar record. Many bridge building projects overshot their estimates, time frames, and some even fell down.)

One of the biggest reasons bridges come in on-time, on-budget and do not fall down is because of the extreme detail of design. The design is frozen and the contractor has little flexibility in changing the specifications. However, in today's fast moving business environment, a frozen design does not accommodate changes in the business practices. Therefore a more flexible model must be used. This could be and has been used as a rationale for development failure.

But there is another difference between software failures and bridge failures, beside 3,000 years of experience. When a bridge falls down, it is investigated and a report is written on the cause of the failure. This is not so in the computer industry where failures are covered up, ignored, and/or rationalized. As a result, we keep making the same mistakes over and over again.

Consequently the focus of this latest research project at The Standish Group has been to identify:

- The scope of software project failures
- The major factors that cause software projects to fail
- The key ingredients that can reduce project failures

Failure Record

In the United States, we spend more than \$250 billion each year on IT application development of approximately 175,000 projects. The average cost of a development project for a large company is \$2,322,000; for a medium company, it is \$1,331,000; and for a small company, it is \$434,000. A great many of these projects will fail. Software development projects are in chaos, and we can no longer imitate the three monkeys -- hear no failures, see no failures, speak no failures.

The Standish Group research shows a staggering 31.1% of projects will be canceled before they ever get completed. Further results indicate 52.7% of projects will cost 189% of their original estimates. The cost of these failures and overruns are just the tip of the proverbial iceberg. The lost opportunity costs are not measurable, but could easily be in the trillions of dollars. One just has to look to the City of Denver to realize the extent of this problem. The failure to produce reliable software to handle baggage at the new Denver airport is costing the city \$1.1 million per day.

Based on this research, The Standish Group estimates that in 1995 American companies and government agencies will spend \$81 billion for canceled software projects. These same organizations will pay an additional \$59 billion for software projects that will be completed, but will exceed their original time estimates. Risk is always a factor when pushing the technology envelope, but many of these projects were as mundane as a drivers license database, a new accounting package, or an order entry system.

On the success side, the average is only 16.2% for software projects that are completed on-time and on-budget. In the larger companies, the news is even worse: only 9% of their projects come in on-time and on-budget. And, even when these projects are completed, many are no more than a mere shadow of their original specification requirements. Projects completed by the largest American companies have only approximately 42% of the originally-proposed features and functions. Smaller companies do much better. A total of 78.4% of their software projects will get deployed with at least 74.2% of their original features and functions.

This data may seem disheartening, and in fact, 48% of the IT executives in our research sample feel that there are more failures currently than just five years ago. The good news is that over 50% feel there are fewer or the same number of failures today than there were five and ten years ago.

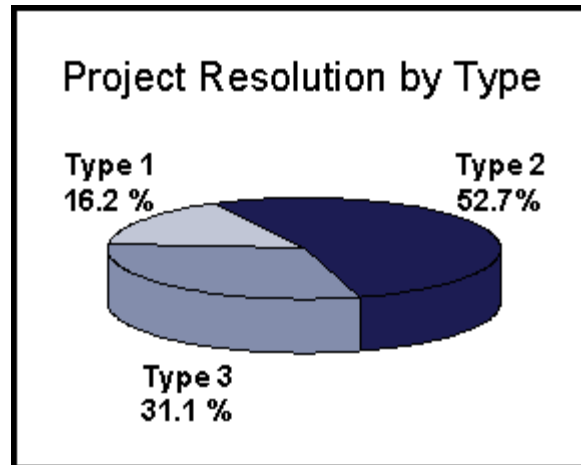
Methodology

The survey made by The Standish Group was as thorough as possible, short of the unreachable goal of surveying every company with MIS in the country. The results are based on what we at The Standish Group define as "key findings" from our research surveys and several personal interviews. The respondents were IT executive managers. The sample included large, medium, and small companies across major industry segments, e.g., banking, securities, manufacturing, retail, wholesale, health care, insurance, services, and local, state, and federal organizations. The total sample size was 365 respondents and represented 8,380 applications. In addition, The Standish Group conducted four focus groups and numerous personal interviews to provide qualitative context for the survey results.

For purposes of the study, projects were classified into three resolution types:

- Resolution Type 1, or project success: The project is completed on-time and on-budget, with all features and functions as initially specified.
- Resolution Type 2, or project challenged: The project is completed and operational but over-budget, over the time estimate, and offers fewer features and functions than originally specified.
- Resolution Type 3, or project impaired: The project is canceled at some point during the development cycle.

Overall, the success rate was only 16.2%, while challenged projects accounted for 52.7%, and impaired (canceled) for 31.1%.



Failure Statistics

The Standish Group further segmented these results by large, medium and small companies. A large company is any company with greater than \$500 million dollars in revenue per year, a medium company is defined as having \$200 million to \$500 million in yearly revenue, and a small company is from \$100 million to \$200 million.

The figures for failure were equally disheartening in companies of all sizes. Only 9% of projects in large companies were successful. At 16.2% and 28% respectively, medium and small companies were somewhat more successful. A whopping 61.5% of all large company projects were challenged (Resolution Type 2) compared to 46.7% for medium companies and 50.4% for small companies. The most projects, 37.1%, were impaired and subsequently canceled (Resolution Type 3) in medium companies, compared to 29.5% in large companies and 21.6% in small companies.

Restarts

One of the major causes of both cost and time overruns is restarts. For every 100 projects that start, there are 94 restarts. This does not mean that 94 of 100 will have one restart, some projects can have several restarts. For example, the California Department of Motor Vehicles project, a failure scenario summarized later in this article, had many restarts.

Cost Overruns

Equally telling were the results for cost overruns, time overruns, and failure of the applications to provide expected features. For combined Type 2 and Type 3 projects, almost a third experienced cost overruns of 150 to 200%. The average across all companies is 189% of the original cost estimate. The average cost overrun is 178% for large companies, 182% for medium companies, and 214% for small companies.

Cost Overruns	% of Responses
Under 20%	15.5%
21 - 50%	31.5%
51 - 100%	29.6%
101 - 200%	10.2%
201 - 400%	8.8%
Over 400%	4.4%

Time Overruns

For the same combined challenged and impaired projects, over one-third also experienced time overruns of 200 to 300%. The average overrun is 222% of the original time estimate. For large companies, the average is 230%; for medium companies, the average is 202%; and for small companies, the average is 239%.

Time Overruns	% of Responses
Under 20%	13.9%
21 - 50%	18.3%
51 - 100%	20.0%
101 - 200%	35.5%
201 - 400%	11.2%
Over 400%	1.1%

Content Deficiencies

For challenged projects, more than a quarter were completed with only 25% to 49% of originally-specified features and functions. On average, only 61% of originally specified features and functions were available on these projects. Large companies have the worst record with only 42% of the features and functions in the end product. For medium companies, the percentage is 65%. And for small companies, the percentage is 74%.

% of Features/Functions	% of Responses
Less Than 25%	4.6%
25 - 49%	27.2%
50 - 74%	21.8%
75 - 99%	39.1%
100%	7.3%

Currently, the 365 companies have a combined 3,682 applications under development. Only 431 or 12% of these projects are on-time and on-budget.

Success/Failure Profiles

The most important aspect of the research is discovering why projects fail. To do this, The Standish Group surveyed IT executive managers for their opinions about why projects succeed. The three major reasons that a project will succeed are user involvement, executive management support, and a clear statement of requirements. There are other success criteria, but with these three elements in place, the chances of success are much greater. Without them, chance of failure increases dramatically.

Project Success Factors	% of Responses
1. User Involvement	15.9%
2. Executive Management Support	13.9%
3. Clear Statement of Requirements	13.0%
4. Proper Planning	9.6%
5. Realistic Expectations	8.2%
6. Smaller Project Milestones	7.7%
7. Competent Staff	7.2%
8. Ownership	5.3%
9. Clear Vision & Objectives	2.9%