Final Results

The results of the survey are organised into four sections: description of the sample; examination of the research question; examination of the hypotheses; and the results of the interviews.

Description of the Sample

26 survey forms were returned and entered into SPSS for data analysis. It is believed that none resulted from the passive (web site based) requests, so it represents a 20% response rate from the 130 direct email requests. The sample is defined by demographic details of the project managers; size of the projects; methodology used; and project resolution.

Project Managers

The project manager data were analysed by gender, age and experience. There was a significant imbalance in the gender of the project managers with 81% being male. The age range was 27 to 62 years with a mean of 44.5 years (Figure 4) and although this shows a bi-modal, platykurtic distribution with a positive skew, analysis of the data using the Kolmogorov-Smirnov (KS) test indicates that this is not significantly different from a normal distribution with $p = 0.200$.

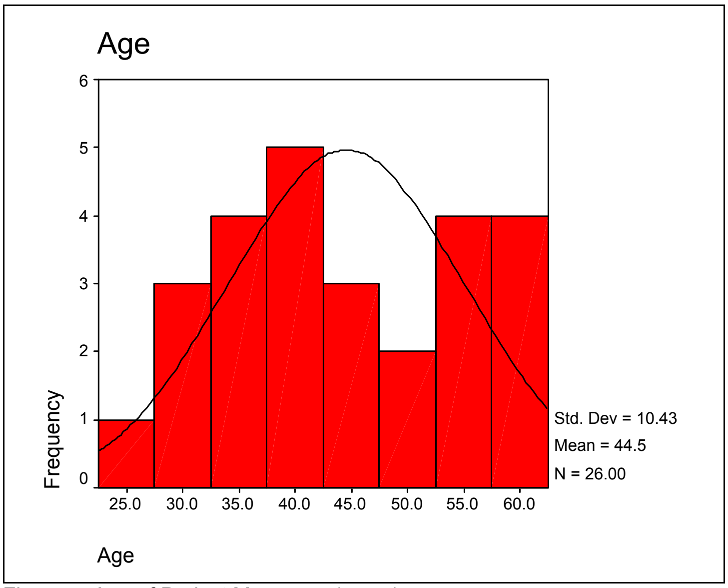

Figure 4: Age of Project Managers (years)

The experience of the project managers ranged from a minimum of 2 years to a maximum of 36 years with a mean of 14.4 years (Figure 5) and again despite the skew and kurtosis, analysis of the data using the KS test indicates that this is not significantly different from a normal distribution with $p = 0.095$. However, given the small size of the sample, the experience data were re-coded into three bands with approximately one third of the cases falling into each band for further analysis.

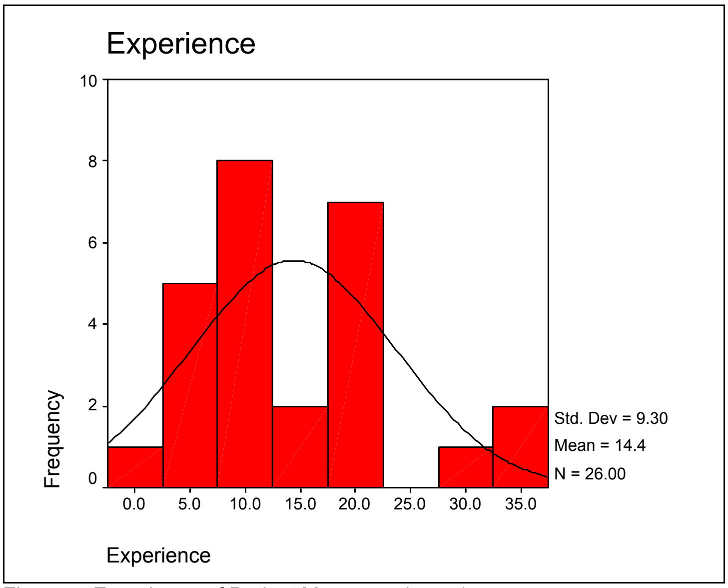

Figure 5: Experience of Project Managers (years)

Project Size

Project size was measured in duration (months), work effort (people/days) and the maximum number of people on the project at any one time. Work effort was not specified in two cases and the data showed a wide range of project sizes with some extreme outliers in two cases. On investigation these turned out to be programmes of multiple projects and their removal produced the results shown in Table 3.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Duration (months)	24	3	12	7.21	2.949
Work Effort (days)	22	35	3330	928.82	986.230
No of People (max)	24	2	110	17.75	24.839
Valid N (listwise)	22				

Table 3: Project Size (with outliers removed)

Analysis of the data using the KS test shows that none of these are normally distributed with duration returning p = 0.027*[1], work effort p = 0.055 and the number of people p = 0.000*** (there still being several outliers in the people data). To enable further analysis of the data, the three size data fields were re-coded into bands (small, medium and large) to each represent, as closely as possible, one third of the cases.

Methodology Used

Figure 6 presents the percentage responses by type of project management methodology used and shows that the majority of respondents were following an in-house methodology (12 cases) or PRINCE2 (8 cases).

[1] Asterisks are used throughout to indicate the degree of significance of probability as follows: * p<0.05, ** p<0.01 and *** p<0.005

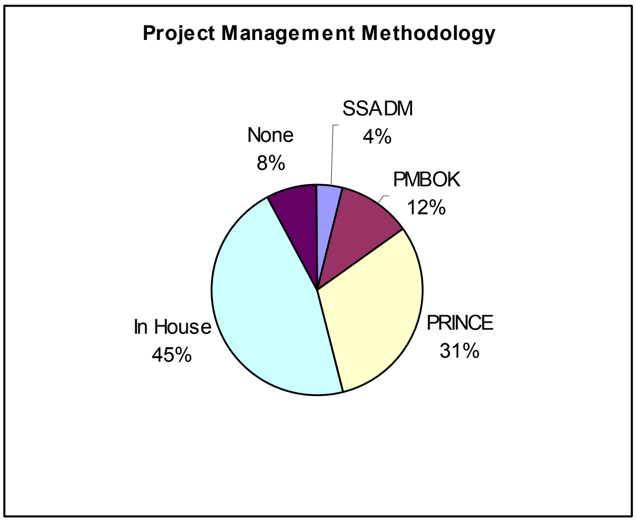

Figure 6: Project Management Methodology Used

Figure 7 shows the percentage response for each Software Development Life Cycle being followed with Waterfall (12 cases), RAD (5 cases) or a combination of the two (3 cases) being the most frequent.

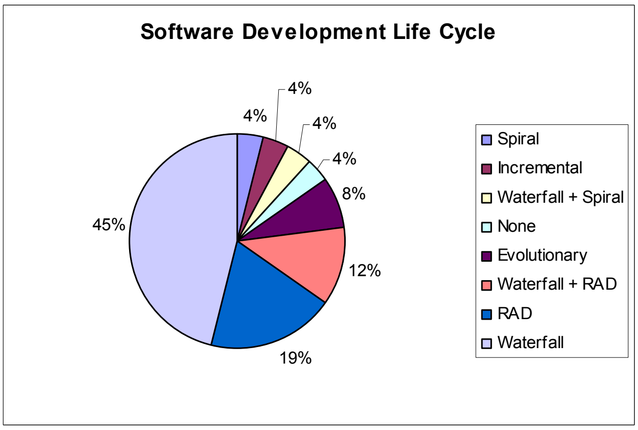

Figure 7: Software Development Life Cycle Used

In addition to the SDLC, a separate in-house Project Management Life Cycle was used in 3 cases, representing 12% of the projects (not illustrated).

Project Resolution

Of the 26 projects, 23 were completed and fully implemented, two were incomplete and one failed. Figure 8 shows the result of 8 successful, 15 challenged and 1 failed project, based on the Standish (2001) project resolution definitions.

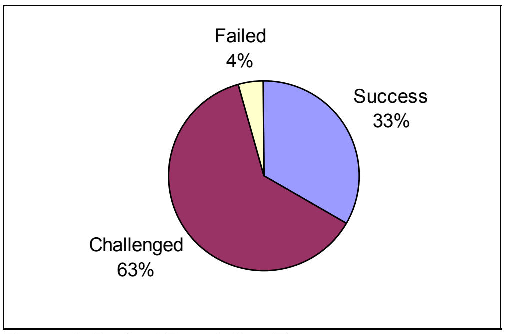

Figure 8: Project Resolution Types

Figure 9 illustrates the analysis of project success criteria for the 15 challenged projects (successful projects implicitly satisfy all three criteria and failed projects satisfy none of them). The most common failing was not being completed on time (60%), followed by exceeding the budget (47%) and failure to implement all features and functionality (27%).

Figure 9: Project Success Criteria (Challenged Projects)

Examination of the Research Question

The central research question was to establish which methodologies, tools and techniques are appropriate and provide benefit to an eBusiness project. The first step was to analyse the data from the 50 process questions (covering tools and techniques). The majority of the responses to the criticality of each process were either 'strongly agree' or 'agree' with a smaller number of 'neutral', very few 'disagree' and no 'strongly disagree'. Figure 10 illustrates the criticality means for each of the 50 processes, which range between 4.15 and 4.81

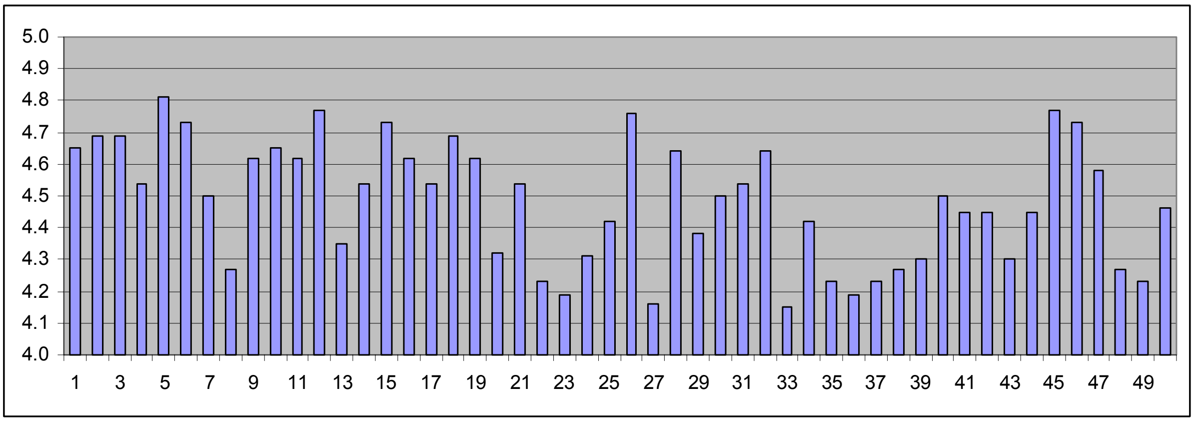

Figure 10: Criticality Means of the 50 Processes

There was a wider variation in the percentage of projects on which the processes were used (illustrated in Figure 11) which ranged between 39% and 100%. The succeeding paragraphs define the main highlights for each of the 10 groups of processes (knowledge areas).

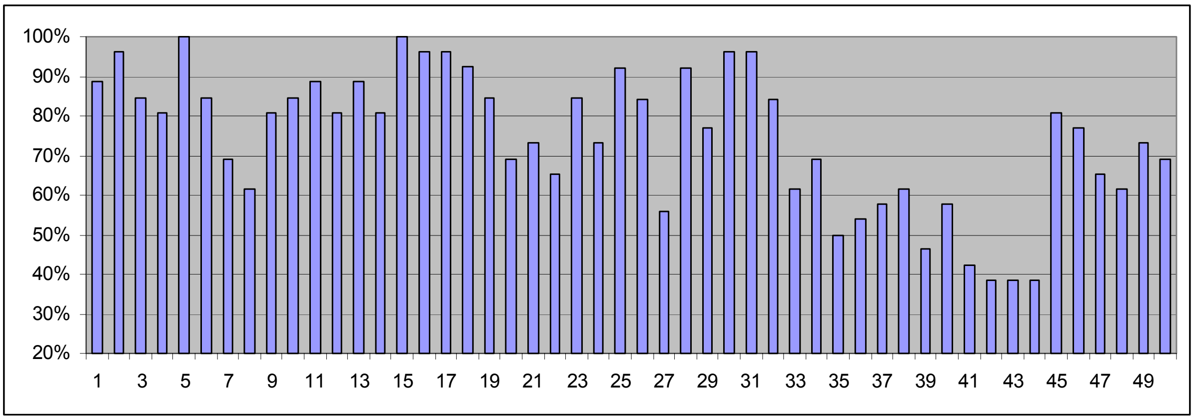

Figure 11: Percentage of projects on which each process was used

Integration Management (processes 1 to 7): these processes have some of the highest criticality means and, apart from (7) project/stage closure, were used on between 85% and 100% of projects, reflecting the strategic nature of the processes in this group. The most critical were: (5) monitoring and controlling project work; (2) preliminary scope statement; (3) project management plan; and (6) integrated change control.

Scope Management (processes 8 to 12): apart from (8) scope planning, these processes were used on between 81% and 89% of projects. Scope planning had a lower criticality mean than the other processes. The most critical process in this group was (12) scope change control and as one respondent commented with the benefit of hindsight; ‘it should have been done properly’.

Time Management (processes 13 to 18): these processes were used on between 81% and 100% of projects with correspondingly high criticality means except for (13) activity definition, which was rated somewhat lower. The most significant processes in this group were (15) activity resource estimating and (18) schedule change control.

Cost Management (processes 19 to 21): (19) cost estimation was used on 85% of projects, (21) cost control on 73% and (20) cost budgeting on 69% which was also reflected in the criticality means. There were no significantly critical processes in this group.

Quality Management (processes 22 to 24): these processes were used on between 65% and 85% of projects with low criticality means. Comments included ‘the project was too small for this’, ‘not yet done’ and ‘went through the motions’.

Human Resource Management (processes 25 to 28): (27) developing the project team was only used on 56% of projects, which could indicate that some project managers do not see it as part of their role. The other processes were used on between 84% and 92% of projects and were considered more critical. The most significant process in this group was (26) acquiring the project team.

Communications Management (processes 29 to 32): these processes were used on between 77% and 96% of projects with criticality means in the mid-range.

Risk Management (processes 33 to 38): these processes appear to be one of the least used groups, with usage ranging from 50% to 69% and the lowest set of criticality means. But from the comments some project managers take a more positive view ‘this was neglected and should have been done better' and 'can't overestimate the importance of risk management'.

Procurement Management (processes 39 to 44): this section was only completed by respondents whose projects involved procurement of goods or services. The processes were used on between 39% and 46% of projects, except for plan contracting which was used on 58%. The criticality means were also generally low and as one respondent put it 'I worked with people I know can do the job'.

Other Project Management (processes 45 to 50): these processes were used on between 62% and 81% of projects. Of these processes, (45) top management support was rated the most critical, followed by (46) full user involvement. On full user involvement, one respondent commented 'full would be straining the truth, mostly until there was a crisis'.

The results of the responses to the 50 processes were ranked by mean, percentage used and standard deviation. While it could be considered that they are all critical, with the lowest mean being 4.15, for the purposes of this study the 10 most critical processes, as identified in the preceding paragraphs, have been selected and are listed in Table 4.

Rank	Project Management Process	Mean	Used on %	Std Dev
1	5. Monitor and Control Project Work	4.81	100.0	0.402
2	12. Scope Change Control	4.77	80.8	0.430
3	45. Top management support	4.77	80.8	0.652
4	26. Acquire Project Team	4.76	84.0	0.523
5	15. Activity Resource Estimating	4.73	100.0	0.452
6	6. Integrated Change Control	4.73	84.6	0.533
7	46. Full user involvement	4.73	76.9	0.604
8	2. Preliminary Project Scope Statement	4.69	96.2	0.471
9	18. Schedule Control	4.69	92.3	0.736
10	3. Project Management Plan	4.69	84.6	0.549

Table 4: Top-10 Processes ranked by Mean, Usage and Standard Deviation

Use of Methodology

The second step in answering the research question was to analyse the use of methodologies. Table 5 illustrates the count of successful, challenged and failed projects by project management methodology. Although there is insufficient data, the value of χ^2 obtained 18.975[a] [2] where $df = 8$ and a significance of $p = 0.015$* (two-sided). It can be observed that there were a greater percentage of successful projects using in-house methodology compared to the use of standard PRINCE2 or PMBOK.

Resolution Type * Methodology Crosstabulation

Count

		Methodology					Total
		None	PRINCE	In House	SSADM	PMBOK	
Resolution Type	Success	1	1	5	1		8
	Challenged		7	5		3	15
	Failed	1					1
Total		2	8	10	1	3	24

Table 5: Resolution by Project Management Methodology

[2] [a] indicates that some cells have expected counts of less than five cases.

Table 6 illustrates the same information by SDLC and there appears to be no statistical significance with the value of χ^2 obtaining 7.997[a] where $df = 12$ and a significance of $p = 0.785$ (two-sided). However, examination of the data would seem to show that the use of a classic waterfall life-cycle is associated with better success rates than RAD or the newer life-cycles.

Resolution Type * SDLC Crosstabulation

Count

		SDLC							
		None	Waterfall	RAD	Incremental	Evolutionary	Waterfall + Spiral	Waterfall + RAD	Total
Resolution Type	Success	1	5	1				1	8
	Challenged		7	3	1	1	1	2	15
	Failed			1					1
Total		1	12	5	1	1	1	3	24

Table 6: Resolution by Software Development Life Cycle

Table 7 shows no advantages or disadvantage to be gained from using a separate PMLC, with exactly one in three projects being successful in either case.

Resolution Type * PMLC Crosstabulation

Count

		PMLC		
		None	In House	Total
Resolution Type	Success	7	1	8
	Challenged	13	2	15
	Failed	1		1
Total		21	3	24

Table 7: Resolution by Project Management Life Cycle

In summary therefore these results would seem to suggest a potential benefit from the use of an in-house project management methodology coupled with a classic waterfall project life-cycle. These were also the most frequently used methodologies which would tend to support the suggestion.

Benefits of Using Processes

The final step in answering the research question was to analyse whether or not the use of a project management process resulted in a higher rate of success. The 26 processes that were used on less than 80% of the projects (where meaningful comparison could be made) were analysed using Chi-square tests and the ranked results are shown in Table 8. While the low volume of cases means the results cannot be treated as statistically significant, they are nevertheless quite instructive.

Of these processes, four showed a significant positive correlation, 12 showed some positive correlation, four showed a neutral or negative correlation and the six sub-contracting processes showed a range between slightly positive and a negative correlation. It can also be seen that only one of these 26 processes (risk identification) had been used on the failed project. For the purposes of this study, it is proposed that the first seven processes with a strong correlation ($p < 0.1$) could potentially provide a benefit to a project.

Rank	Process	Used			Not Used			Sig. one-tailed
		Success	Challgd.	Failed	Success	Challgd.	Failed	
1	7. Project Closure	8	13	0	0	2	1	0.009**
2	46. Full user involvement	8	10	0	0	5	1	0.023*
3	49. Issue management	8	10	0	0	5	1	0.023*
4	29. Communications Planning	8	11	0	0	4	1	0.023*
5	48. Team empowerment	7	8	0	1	7	1	0.057
6	24. Quality Control	7	10	0	1	5	1	0.082
7	45. Top management support	7	12	0	1	3	1	0.063
8	8. Scope Planning	6	9	0	2	6	1	0.163
9	27. Develop Project Team	5	8	0	3	6	1	0.246
10	35. Qualitative Risk Analysis	5	7	0	3	8	1	0.229
11	20. Cost Budgeting	6	11	0	2	4	1	0.141
12	21. Cost Control	6	11	0	2	4	1	0.141
13	22. Quality Planning	6	10	0	2	5	1	0.163
14	34. Risk Identification	6	10	1	2	5	0	0.370
15	47. Established business case	6	9	0	2	6	1	0.163
16	36. Quantitative Risk Analysis	5	9	0	3	6	1	0.239
								Sig. two-tailed
17	37. Risk Response Planning	5	10	0	3	5	1	0.411
18	38. Risk Monitoring and Control	5	10	0	3	5	1	0.411
19	50. Configuration management	5	11	0	3	4	1	0.307
20	33. Risk Management Planning	4	11	0	4	4	1	0.229
21	40. Plan Contracting	4	10	0	1	3	0	0.888
22	39. Plan Purchasing	3	8	0	2	5	0	0.952
23	41. Request Seller Response	3	8	0	2	5	0	0.952
24	42. Select Seller	2	7	0	3	6	0	0.599
25	44. Contract Closeout	2	7	0	3	6	0	0.599
26	43. Contract Administration	2	8	0	3	5	0	0.410

Table 8: Project resolution by process use and non-use

Examination of Hypotheses

In addition to the research question there were three hypotheses to be examined: that project managers would use the processes they believed to be critical to the success of a project; that there would be a positive relationship between the level of experience of the project manager and the likelihood of success of the project; and that there would be an inverse relationship between the size of the project and the likelihood of success.

Use of Critical Processes

If project managers actually use the processes they believe are critical to project success, then a correlation should be found between the two. Figure 12 is a scatter plot illustrating the comparison of the criticality mean to the percentage use. The value of Pearson's Correlation obtained $r = 0.615$** which is significant at the 0.01 level (one-tailed) and therefore appears to support the hypothesis.

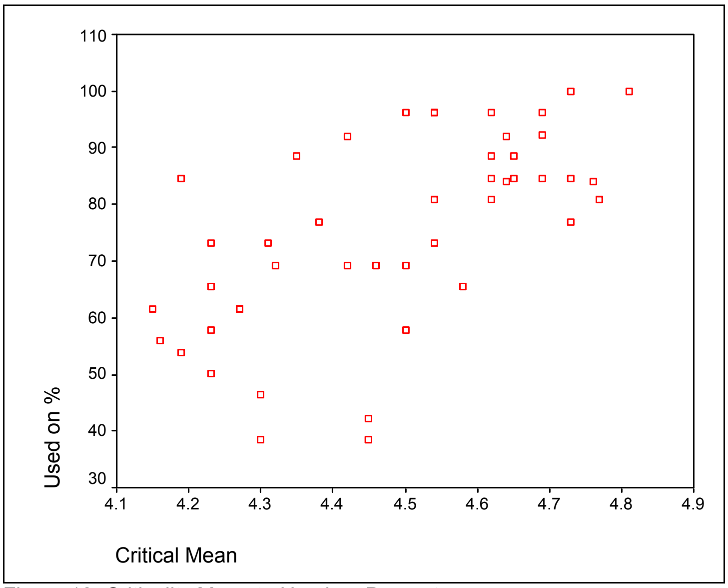

Figure 12: Criticality Mean to Used on Percentage

Further analysis of the 50 individual processes was performed using a Mann-Whitney *U* test as the criticality data are non-parametric. Two of the processes were used on all projects so no comparison could be made. The remaining 48 all display a positive difference (34 of these being significant) in mean criticality between projects using the process and projects not using the process, which would seem to further support the hypothesis.

Project Manager's Experience

Table 9 shows a cross tabulation of the project resolution by project manager's experience. Use of a Chi-square test indicated that there is no significant correlation with the value of χ^2 obtaining 2.404[a] where $df = 4$ and a significance of $p = 0.331$ (one-sided). This means that the hypothesis is not supported by the data and that the project manager's experience does not appear to have an effect on the success of a project.

Resolution Type * Experience (years) Crosstabulation

Count

		Experience (years)			
		< 10	10 - 19	> 19	Total
Resolution Type	Success	3	2	3	8
	Challenged	4	5	6	15
	Failed	1			1
Total		8	7	9	24

Table 9: Project Resolution by Level of Experience

Project Size

The third hypothesis, that there would be an inverse relationship between the size of a project and its likelihood of success, was examined using cross tabulations of project resolution by duration, work effort and the maximum number of people on a project. Table 10 shows the project duration and Chi-square analysis indicates that the difference is not quite statistically significant with the value of χ^2 obtaining 5.657[a] where $df = 4$ and a significance of $p = 0.113$ (one-sided), or a one in ten chance of this result occurring naturally. However, examination of the data shows that there was a 50% success rate for projects of less than six months duration, a 40% success rate for projects of six to nine months duration and no successful projects over nine months duration which would appear to support the hypothesis.

Resolution Type * Duration (months) Crosstabulation

Count

		Duration (months)			Total
		< 6	6 - 9	> 9	
Resolution Type	Success	3	4		7
	Challenged	3	5	6	14
	Failed		1		1
Total		6	10	6	22

Table 10: Resolution by Project Duration

Table 11 shows the work effort cross tabulation and there appears to be a better percentage of successful projects in the smaller size band but marginally more successful large projects than medium ones. Chi-square analysis showed no statistical significance to these results.

Resolution Type * Work Effort (days) Crosstabulation

Count

		Work Effort (days)			Total
		< 250	250 - 1100	> 1100	
Resolution Type	Success	3	1	2	6
	Challenged	4	5	5	14
	Failed		1		1
Total		7	7	7	21

Table 11: Resolution by Work Effort

Table 12 shows the maximum number of people cross tabulation and again there appears to be a better percentage of successful projects in the smaller size band and more successful large projects than medium ones. Chi-square analysis again indicates no statistical significance to this.

Resolution Type * No of People (max) Crosstabulation

Count

		No of People (max)			Total
		< 6	6 - 12	> 12	
Resolution Type	Success	4	1	2	7
	Challenged	4	6	4	14
	Failed		1		1
Total		8	8	6	22

Table 12: Resolution by Maximum Number of People on the Project

In summary therefore, while there is insufficient data to statistically support this hypothesis, there does seem to be a better rate of success for small projects and there would seem to be a good case for restricting the duration of a project to no more than nine months.

Interview Results

In order to ascertain if any additional elements of methodology, tools or techniques had been overlooked by the survey, interviews with three project managers were carried out. While several of the critical factors already identified were mentioned, they also identified two additional critical factors: having a good, dependable team; and having a good technical lead developer.

All three were using in-house project management methodology (PRINCE2 based) although one preferred a previous employer's in-house methodology (PMBOK based), one found it too restrictive and one commented that it should be reviewed annually. All three preferred an iterative SDLC and all used the following tools:

- Microsoft Project for scheduling
- Microsoft Excel for estimation
- Microsoft Word for plans status reports
- In-house system for risk and issue tracking
- In -house system for document management

These final results form chapter 4 of the dissertation on the study. The dissertation also includes the literature review, research methodology, discussion of the results and conclusion and recommendations.

John Carroll
31-March-2005