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# **A Study of Financial Analysis Expectations and Practices in the Engineering Management Workplace**

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## **Abstract**

This paper describes an on-going study of Master of Engineering Management (MEM) students and the financial analysis related job expectations and environment they face. The objective of this effort is to provide enhanced understanding of these requirements so that instructional content in the related courses can be focused to meet these needs. To achieve this goal, the study segments findings based on a range of organizational and job level characteristics to identify critical differences in the financial work environment and the financial tools that are employed. Preliminary findings are discussed in this paper and contrasts between public and private sector practices are examined.

## **I. Introduction**

Master of Engineering Management (MEM) programs offer unique educational challenges to faculty. First, most students are several years or more into their career and have strong opinions on job related requirements. As a result, they judge the quality of course content, in large part, based on the likelihood of application and use of this material in the work place. This issue of workplace application of course material leads to a second challenge. Since the activities and tasks in the engineering management work place are both diverse and constantly changing, the instructor's challenge is to provide material that is immediately useful to a wide range of work environments but yet maintains shelf life for application several years into the future.

MEM students have particularly high expectations related to financial analysis skills. A primary reason for this is that many technical and engineering oriented students select MEM programs in lieu of alternative business related programs such as the MBA. Consequently, there is an expectation that the MEM program provide a high degree of the "business sense" that is perceived to be critical for climbing the corporate or organizational ladder. The success in meeting these expectations is primarily based on the materials in the financial analysis course(s) similar to graduate level engineering economics.

Several studies have examined the financial analysis tools that corporations employ [1,2]. But these studies did not specifically track the translation of these tools into the engineering management work place at the operating manager (first level manager, second level manager, and program / project manager) and engineer level. Consequently they are of limited use to the MEM instructor since they provide high - level organizational data, primarily from larger public sector firms. The study described in this paper targets development of detailed understanding of the financial analysis practices specifically employed in the MEM student work place. From a

broader view, the goal of this research is to conduct a longitudinal study that will answer the following questions:

- What are the work place expectations for use of financial and cost analysis tools by MEM students?
- What is the larger business environment for strategic application of financial analysis?
- What specific financial analysis tools are employed in the MEM student workplace to analyze investments and projects?
- Are there differences in the previous questions based on organizational factors such as public / private sector, publicly traded or privately held for – profit firms, annual sales volume, job level, and type of industry?

The next section describes the preliminary results of the trial survey that initiated this study.

## II. Preliminary Survey Results

Beginning in 1999, a preliminary survey was conducted to refine the research questions and methodology. Two classes of MEM students enrolled in “Cost Estimating and Financial Analysis” (the core financial course in the MEM program at Old Dominion University) were asked to participate voluntarily in a survey to examine the financial analysis tools and expectations in their workplace. The results of that effort are discussed in this section and represent responses from over forty students or about 40% of the course population. The characteristics of the survey sample are summarized below:

- 44% of the respondents work in the public sector and 56% in the private sector.
- Over 90% of the public sector group works in defense related activities.
- Over 75% of the participants had over four years of experience and 55% had over ten years experience.
- Over 90% of the private sector group is employed by American owned firms with sales in excess of \$1B and a primary emphasis on manufacturing.

Exhibit 1 describes the distribution of participant job descriptions.

Exhibit 1 Job Description Distribution of Survey Participants

Design, engineering or research related	First level supervision or team leader	Second level supervision or above	Project or program manager	Other
39%	24%	12%	22%	2%

The survey focused on two areas. The first section examined job expectations and the general financial analysis environment. The second section examined the application of specific tools. The following sections provide the preliminary results and highlight public and private sector differences in response. In the long term, the data size will grow and additional difference factors will be examined including firm size, publicly traded or privately held, public sector level, and others.

## III. Financial Analysis Job Expectations and Environment

The first survey sector targeted identification of the job expectations and financial analysis environment faced by MEM students. A critical starting point is exploration of the job expectations to conduct financial analysis of projects and cost analysis of budgets. Exhibit 2

shows that only 1/3 of the organizations expect engineering and technical management personnel to analyze projects financially. There was no statistical difference between the public and private sector responses.

Exhibit 2 Expectation for Financial Analysis of Projects

Project financial analysis - I am expected to analyze the financial aspects of engineering projects in which I am involved.			
	Public Sector	Private Sector	Statistical significance
Always or frequently	33%	34%	Sectors not different
Seldom or never	61%	63%	
Don't Know	6%	0%	

The next job expectation related question examined whether employers expect MEM students to analyze costs or develop budgetary information. Exhibit 3 shows that the expectation for cost and budget analysis is at least as common a work place expectation as financial project analysis. Once again there is no statistical difference between the public and private sector expectations.

Exhibit 3 Expectation for Cost / Budget Analysis

Cost / budget analysis - I am expected to estimate, analyze, or prepare cost information for operating or project budgets.			
	Public Sector	Private Sector	Statistical significance
Always or frequently	44%	30%	Sectors not different
Seldom or never	56%	70%	

Organizations that involve engineering and technical personnel in business planning and application of financial analysis tools should have methods that are clearly understood. The survey examined whether MEM students believed this was the case, and Exhibit 4 contains the summary of responses. Exhibit 4 shows that the majority of respondents in both the public and private sectors disagree or strongly disagree that financial methods are understood. Exhibit 4 parallels Exhibit 2 and 3 in an undesirable way. Over half of the responses in Exhibit 2 and 3 do not have a workplace expectation to apply financial and cost analysis. Similarly, over half of the responses in Exhibit 4 do not have clearly understood financial methods.

Exhibit 4 Environment - Clearly Understood Financial Methods

Financial practices - The methods my organization uses for financial analysis of engineering projects are understood by engineering personnel.			
	Public Sector	Private Sector	Statistical significance
Strongly agree or agree	28%	13%	Sectors not different
Strongly disagree or disagree	50%	65%	
No opinion or don't know	22%	22%	

There is a notable issue in the private sector data in Exhibit 2,3, and 4. Exhibit 2 indicates that 34% of the private sector respondents were expected to analyze projects and Exhibit 3 shows that 30% are expected to analyze costs and budgets. However, Exhibit 4 shows that only 13% of private sector participants agree that financial methods are clearly understood. This is a statistically significant difference with Exhibit 2 and 3 at the 90% confidence level.

If effort is spent to analyze projects and costs, it is important to understand the broader, strategic contexts in which this analysis is applied. A series of questions explored the financial analysis environment by examining issues such as how projects are prioritized, strategic planning, and portfolio analysis. As a starting point, MEM students were asked whether projects were prioritized based on financial factors. Exhibit 5 shows those responses and indicates a statistically significant difference between the public and the private sector in this response. It is noteworthy that 39% of the private sector responses and 67% of the public sector responses indicate that projects in their organizations are NOT prioritized based on financial results.

**Exhibit 5 Project Prioritization Based on Financial Results**

Organizational Environment - In my organization, engineering projects are prioritized based on measurable financial results			
	Public Sector	Private Sector	Statistical significance
Always or frequently	28%	52%	Sectors are different at 90% confidence level
Seldom or never	67%	39%	
No opinion or don't know	6%	9%	

The last series of questions on the financial environment examined the match of project selection to a strategic planning process and Exhibits 6, 7, and 8 present those results. Exhibit 6 shows that over 70% of respondents indicated that engineering management is involved in strategic planning decisions in their organizations. Consistent with Exhibit 6, Exhibit 7 indicates that over 60% of both public and private sector responses say that engineering projects are related to the strategic plan of the organization. However, Exhibit 8 indicates that in the MEM student workplace, portfolio tools are seldom used (6% in the public sector and 17% in the private sector) to analyze the mix of projects with the strategic plan. This sector difference is statistically significant at the 80% confidence level.

**Exhibit 6 Engineering Management Involvement in Strategy Decisions**

Organizational Environment - In my organization, engineering managers are involved in strategic planning and critical business and technical decisions.			
	Public Sector	Private Sector	Statistical significance
Always or frequently	72%	74%	Sectors not different
Seldom or never	17%	22%	
No opinion or don't know	11%	4%	

**Exhibit 7 Projects Related to Strategic Plan**

Organizational Environment - In my organization, engineering projects are clearly related to a strategic plan.			
	Public Sector	Private Sector	Statistical significance
Always or frequently	61%	74%	Sectors not different
Seldom or never	28%	17%	
No opinion or don't know	11%	9%	

**Exhibit 8 Use of Portfolio Analysis to Match Projects to Strategic Goals**

Organizational Environment - My organization uses portfolio analysis to analyze the mix of projects and the match with each other and strategic goals.			
	Public Sector	Private Sector	Statistical significance
Always or frequently	6%	17%	Sectors are different at 80% confidence level
Seldom or never	67%	39%	
No opinion or don't know	28%	43%	

A critical issue in the credibility and quality of financial and cost analysis involves the post project audit process. A consistent audit of project results contributes to a more thorough effort to develop accurate financial projections that are met. Exhibit 9 shows that 22% of public sector groups audit project results while 39% of private sector groups perform audits. This difference is statistically significant at 80% confidence.

**Exhibit 9 Use of Project Audits**

Organizational Environment - My organization audits projects after completion to assure that results have been achieved.			
	Public Sector	Private Sector	Statistical significance
Always or frequently	22%	39%	Sectors are different at 80% confidence level
Seldom or never	61%	48%	
No opinion or don't know	17%	13%	

**IV. Financial Analysis Tools**

This section examines the basic and advanced analytical tools that are employed in the MEM student work place. A starting point is to define the prevalence of basic tools and differences in application. Exhibit 10 summarizes survey responses and indicates significant application differences in NPV, IRR and Benefit / cost analysis. A surprising result is the use of both payback period and return on investment measures in both the public and private sector. ERR was the least used method by the survey group.

**Exhibit 10 Financial Methods Employed**

Methods employed - My organization uses the following financial methods to analyze projects and operational performance:			
	Public Sector	Private Sector	Statistical significance
NPV	33	52	Sectors different at 80% confidence
IRR	0	48	Sectors different at 90% confidence
ERR	6	13	Not significant
Payback	44	57	Not significant
ROI	39	52	Not significant
ABC	28	35	Not significant
B/C	61	30	Sectors different at 90% confidence

The second set of analytical tools targeted advanced methods and focused on risk analysis approaches. Exhibit 11 indicates that advanced tools exemplified by risk analysis methods are seldom employed in the MEM work place. 72% of the public sector and 57% of the private

sector responses indicated that risk tools are not used or were not aware of their use. On the other hand, the most frequently used risk tool was sensitivity analysis with 6% of the public sector and 26% of the private sector. Simulation was used by only 6% of the public sector responses.

Exhibit 11 Use of Risk Analysis Methods

Risk analysis - My organization considers risk in financial evaluation of projects by employing:			
	Public Sector	Private Sector	Statistical significance
Sensitivity analysis	6	26	Sectors different at 90% confidence
Risk adjusted return	0	9	Not significant
Other	17	9	Not significant
Simulation	6	0	Not significant
Don't know	28	22	Not significant
Risk not considered	44	35	Not significant

## V. Summary and Conclusions

This paper provided preliminary results of a study to enhance understanding of the financial analysis needs of the changing workplace of the MEM student population. The current results indicate a number of surprising outcomes. On the negative side, the workplace experienced by MEM students has the following characteristics relating to financial analysis tools:

- Only about 1/3 of public and private sector organizations expect engineering and technical personnel to financially analyze projects or perform cost analysis for budgetary or forecast needs.
- Similarly, 2/3 of responses indicated technical personnel do not understand their organization's financial analysis methods.
- Only 28% of public sector responses indicate projects are prioritized based on financial analysis.
- Advanced analytical tools including risk analysis and portfolio analysis are seldom used in the MEM student work place.
- Project audits seldom occur in the public sector and in only about 40% of the public sector organizations.

On the positive side, the survey showed that engineering management is involved in the strategic planning process and technical projects are often related to the strategic plan.

The authors plan to continue this survey for several more years and solicit increased involvement from other MEM programs throughout the country. We hope that this study may also be a model for increased collaboration in other subject matter areas that are critical to MEM programs and students.

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