Quantitative Software Management, Inc.
2000 Corporate Ridge, Suite 700
Mclean, VA 22102
703.790.0055 • 703.749.3795 (fax)
info@qsm.com • www.qsm.com

FUNCTION POINT ANALYSIS OVER THE YEARS

Background

- QSM has a large software project database with more than 10,000 entries collected over 35 years
  - Many projects sized in IFPUG function points
- QSM frequently performs benchmark and productivity studies for customers
- Wanted to examine projects sized in function points completed since 2000 focusing on
  - Demographics
  - Productivity
  - Effort
  - Schedule
  - Staffing
  - Impact of analysis and design
  - Trends over time

Process

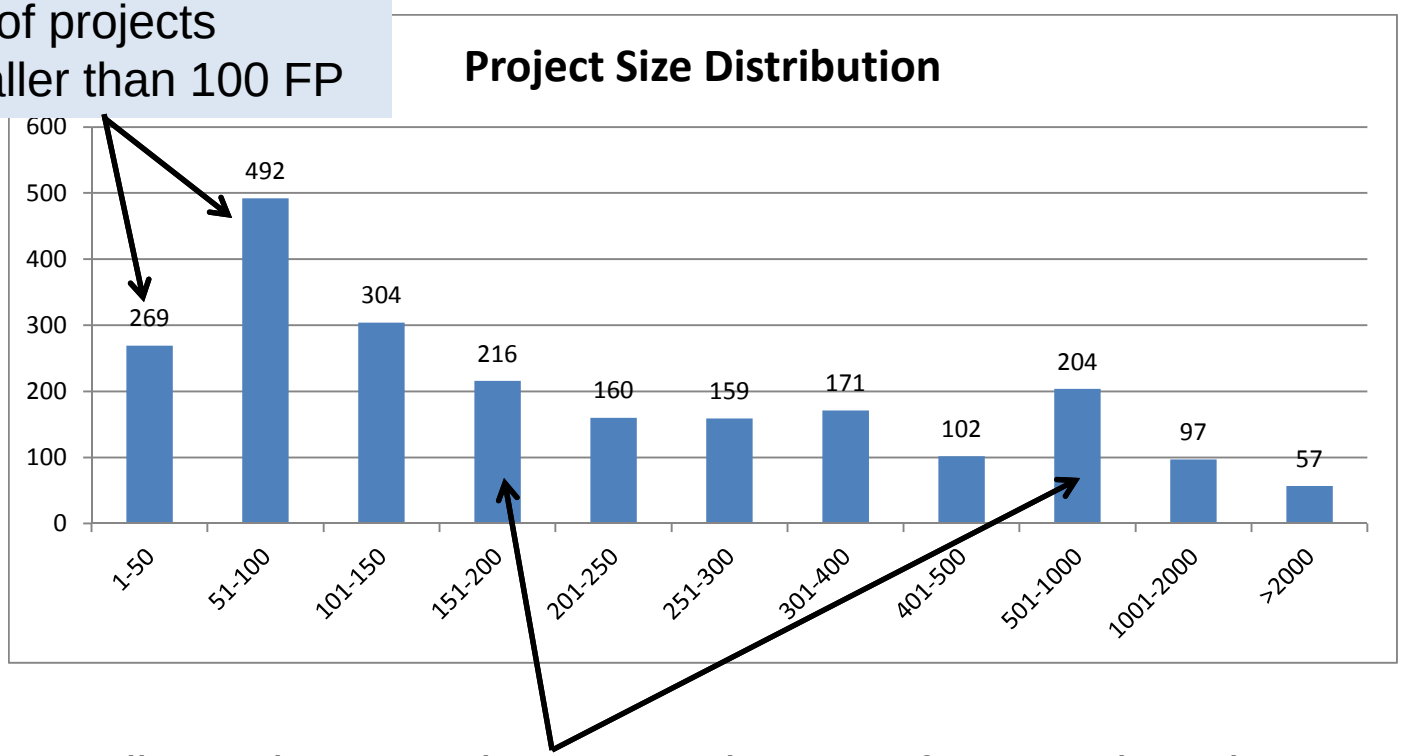
- Extract all FP projects completed since 2000
- Select projects that have schedule and effort from the beginning of Analysis up until implementation into production
- Cull out suspect projects (extreme outliers & projects with incomplete or contradictory data)
- Resulting sample size 2,231 projects
- All projects reported IFPUG function points (No NESMA, COSMIC, or Mark II)
- Analysis done on unadjusted function points

Demographics

- 20 countries represented (U.S., Europe, Canada, Brasil, Australia largest contributors)
- 43 companies/organizations
- What does the "typical" project look like?
  - Business IT (98% of sample)
  - Median size 160 UFP
  - Median schedule (analysis to implementation) 7.03 mths
  - Median effort 21.85 person mths. (3,496 phrs at 160 phr/pm)
  - Average staff 2.3 FTE
  - Labor cost $262,200 at $75/hr. and 160 hrs./mth.
  - 13% of effort spent in high level analysis & design

Project Size Distribution

1/3 of projects smaller than 100 FP



Smaller projects are the norm. There are fewer projects between 500 and 1000 FP than there are between 150 and 200

Project Effort Distribution

Project Size & Effort Distribution		
Function Points	**% Projects**	**% Effort**
<=100	34%	11%
101 - 200	23%	14%
201 - 300	14%	14%
301 - 500	12%	14%
501 - 1000	9%	16%
1001 - 2000	4%	13%
Larger	3%	17%

Although the largest projects make up only a small percentage of the total, their overall cost/effort is greater than any other size category

Project Types and Distribution

- QSM classifies software development projects by the ratio of new code to modified, deleted, and reused code:
- New development (> 75% new functionality)
- Major enhancement (25% - 75% new functionality)
- Minor enhancement (5% - 25% new functionality)
- Conversion (< 5% new functionality)
- Maintenance

Project Types and Distribution

	New Development	Major Enhancement	Minor Enhancement	Conversion	Maintenance
Percent of Projects	16%	61%	14%	7%	2%
Median PI	14.0	10.1	11.2	9.9	10.4
Median size (FP)	291	119	153	109	68
Median effort mont	29.7	19.3	28.1	23.4	18.6
Median % Funct Eff	12%	11%	12%	10%	19%
Median FP/PM	9.16	5.79	5.19	5.06	2.70
Median Duration	7.57	7.23	6.42	6.43	4.73
Median Defects	37.00	16.00	38.50	35.00	16.00

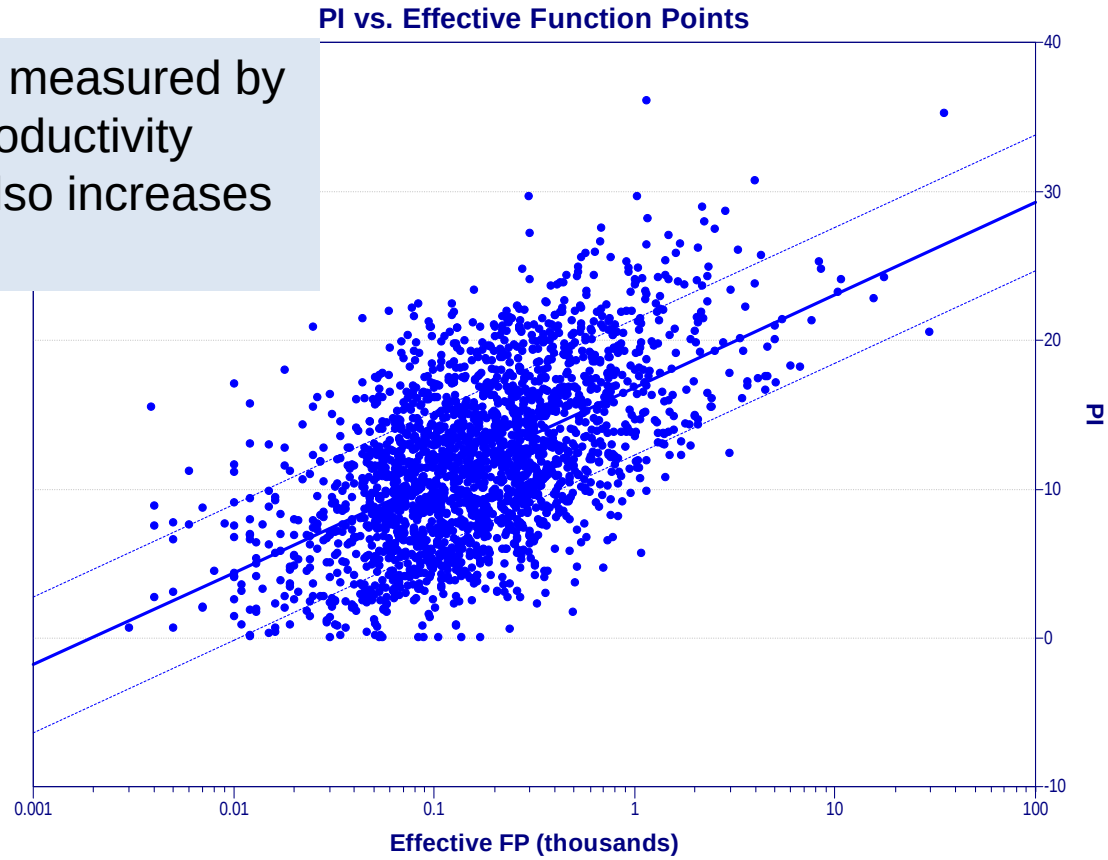
- 75% of the projects are enhancements
- The development types vary in size, productivity, and quality

Productivity: The Role of Size

Productivity by Size Category		
Size (FP)	**Count**	**FP/PM (Median)**
<=50	269	3.49
51-100	492	5.13
101-150	304	6.54
151-200	216	6.67
201-250	160	7.65
251-300	159	8.49
301-400	171	9.55
401-500	102	9.72
501-1000	204	13.43
1001-2000	97	16.29
>2000	57	23.10

Productivity: The Role of Size

Productivity measured by the QSM productivity index (PI) also increases with size



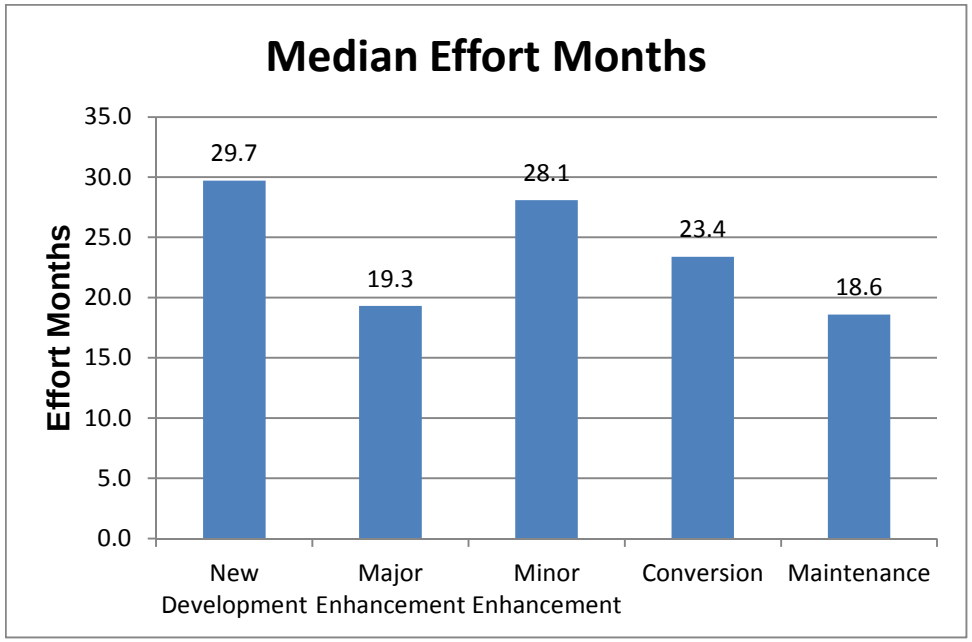
Why Are Larger Projects More Productive?

- More important to organizations
  - Higher visibility
  - May benefit from better leadership and more skilled resources
  - Scalability issues with smaller projects?
- However
  - More likely to be cancelled
  - Productivity only calculated from completed projects
  - Inefficient smaller projects may be allowed to complete

Project Effort

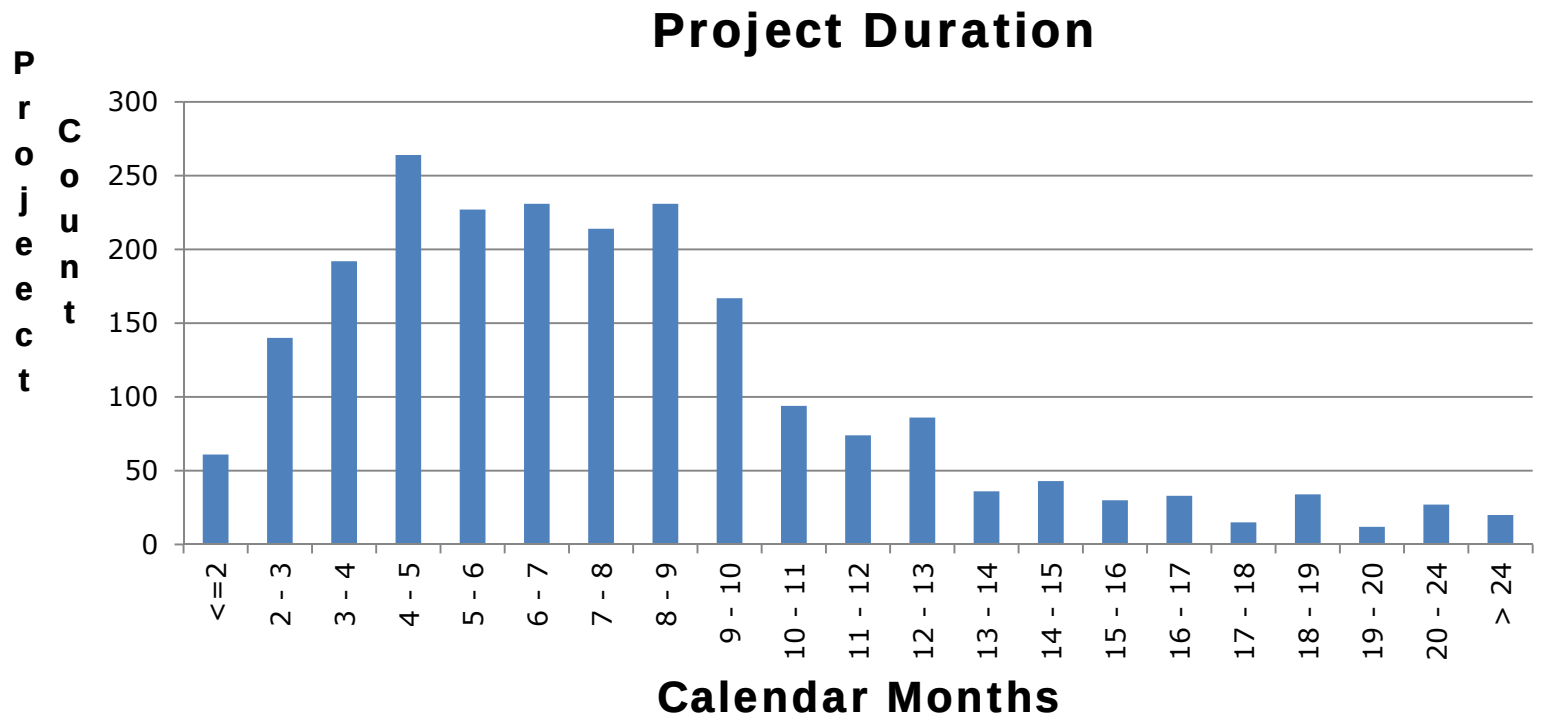
Effort	Project Count	% of Projects	FP/PM (Median)	Median Size (FP)
<=10 PM	487	21.83%	11.6	72
>10 <=20	551	24.70%	7.86	113
>20 <=30	323	14.48%	5.87	139
>30 <=40	194	8.70%	5.65	194
>40 <=50	127	5.69%	5.44	247
>50 <=60	109	4.89%	5.32	301
>60 <=70	67	3.00%	4.45	292
>70 <=80	60	2.69%	4.73	348
>80 <=90	38	1.70%	3.45	292
>90 <=100	30	1.34%	3.32	312
>100 <=150	102	4.57%	3.12	359
>150 <=200	52	2.33%	3.44	606
>200 <=300	45	2.02%	2.66	597
>300 <=400	12	0.54%	3.13	1,041
>400 <=500	13	0.58%	3.33	1,477
>500 <=1000	14	0.63%	3.11	1,989
>1000	7	0.31%	2.55	3500

Project Effort



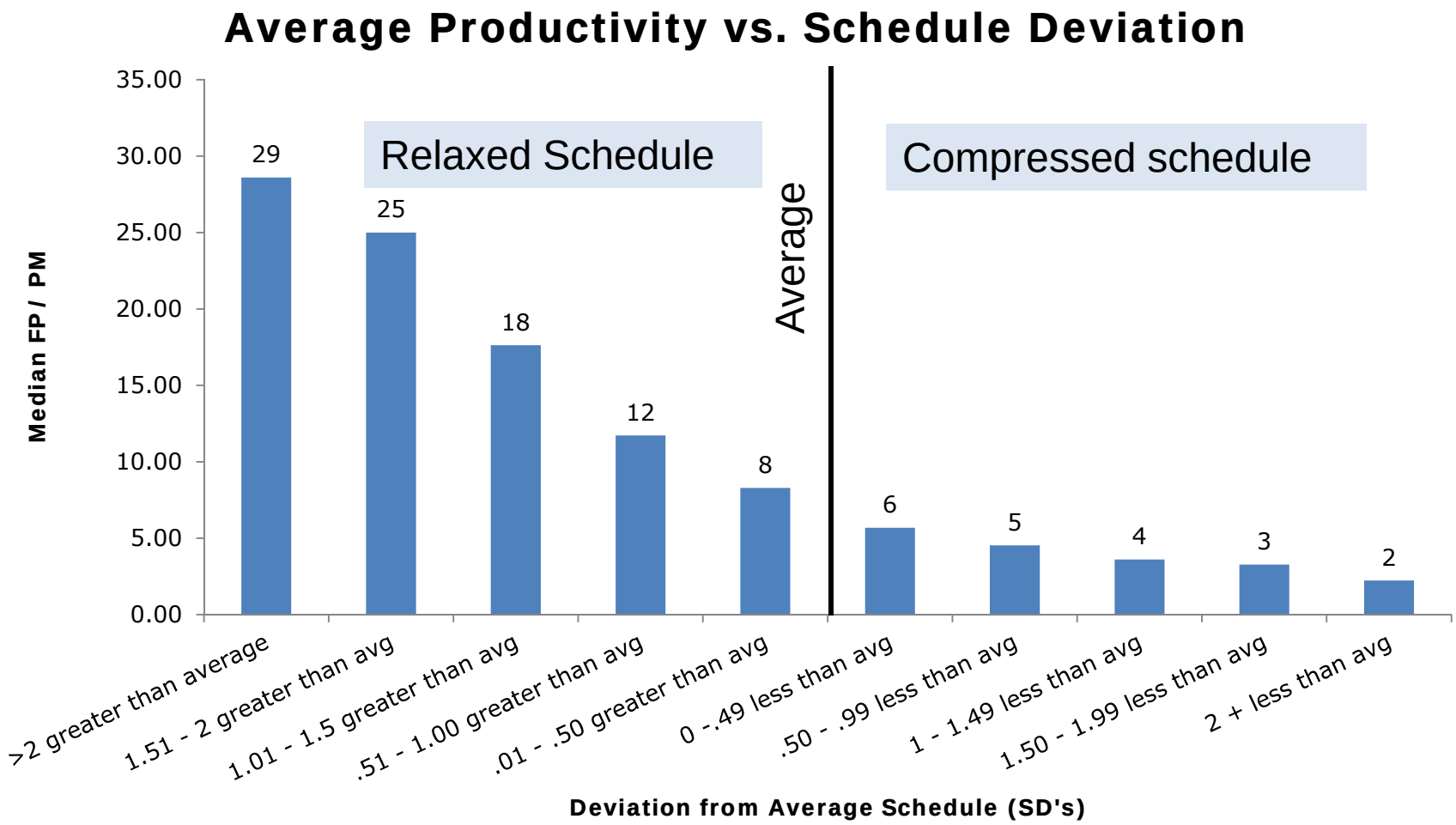
Median effort varies by project type. Median effort for new development and minor enhancements is nearly the same while new development projects are nearly twice as large

Project Schedule Distribution



- 50% of FP projects complete within 7 months
- 70% complete within 9 months
- 85% complete within 1 year

Project Schedule
The Impact of Compression



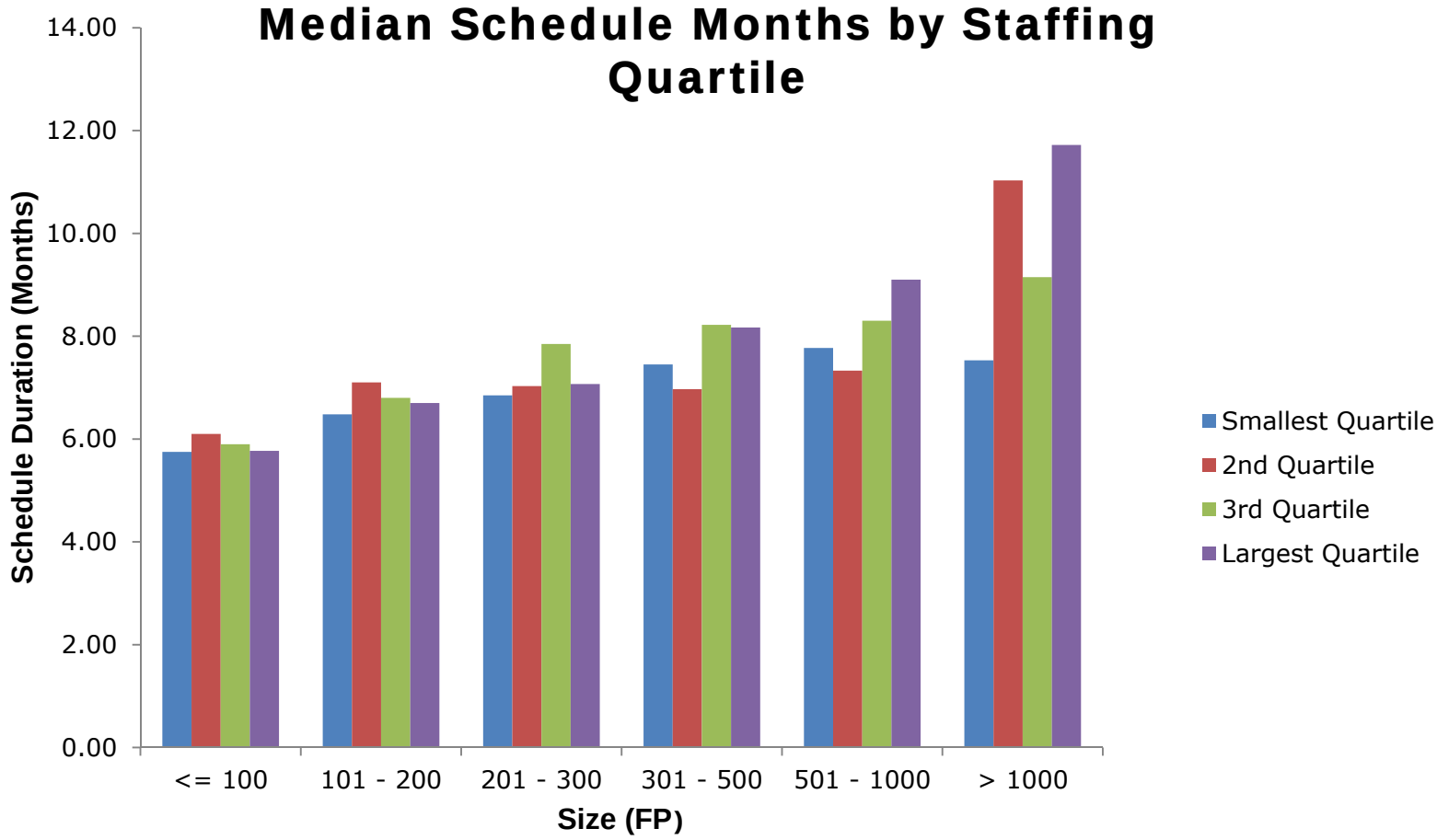
Project Staffing

Productivity Rates (FP/PM) Smallest to Largest Staffing Quartiles					
Size Range (FP)	Lowest Staffing Quartile		Highest Staffing Quartile		Productivity Ratio
	Productivity (FP/PM)	Median Staff (FTE)	Productivity (FP/PM)	Median Staff (FTE)	
1-100	7.17	0.86	2.57	2.53	2.77 to 1
101-200	13.68	1.19	2.83	4.41	4.83 to 1
201-300	17.44	1.59	3.15	6.62	5.54 to 1
301-500	27.15	1.73	3.96	7.47	6.86 to 1
501-1000	34.96	1.76	4.35	10.95	8.04 to 1
>1000	45.29	2.86	5.76	15.04	7.86 to 1

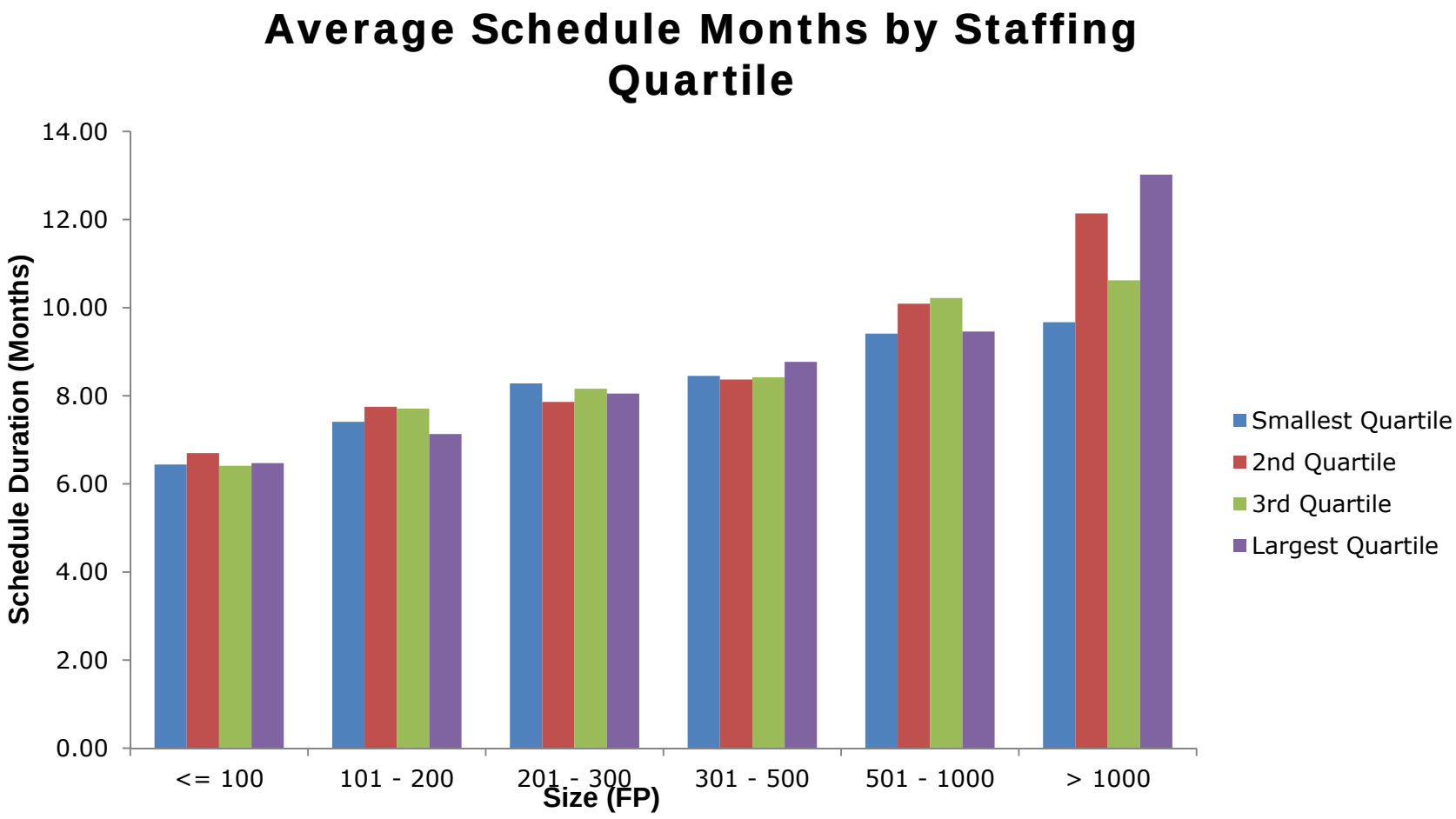
Lower staffing levels are associated with higher productivity. Projects in the lowest staffing quartile are between 277% and 804% more productive than projects in the highest staffing quartile.

But, schedule is often the primary project constraint. Don't lower staffing levels have a negative impact on schedule?

Project Staffing



Project Staffing



Impact of Analysis and Design

Projects that invested 20% or more of their total effort in analysis and design completed sooner, required less total effort, were more productive, and had fewer defects

Comparison at 20% Design Effort		
Medians		**% Difference**
PI <= 20%	11.04	
PI > 20%	14.19	29%
FP/PM <= 20%	6.20	
FP/PM > 20%	7.93	28%
Duration <= 20%	7.23	
Duration >20%	6.20	-17%
Total Effort <=20%	22.59	
Total Effort > 20%	20.29	-11%
Average staff <= 20%	2.34	
Average staff > 20%	2.50	7%
FP size <= 20%	157.00	
FP size > 20%	171.00	9%
Defects <= 20%	20.00	
Defects > 20%	19.50	-3%

Trends over Time
Languages

Top 10 Software Languages			
1990-1994	**1995-1999**	**2000-2004**	**2005 +**
COBOL	COBOL	COBOL	JAVA
PL/1	POWERBUILDER	JAVA	COBOL
NATURAL	C	PL/1	IEF/COOL:GEN
TELON	C++	C++	PL/1
SQL FORMS	VISUAL BASIC	VISUAL BASIC	Cognos Impromptu Scripts
C++	SQL FORMS	IEF/COOL:GEN	PACBASE
C	SQL	POWERBUILDER	.net
ASSEMBLER	PL/1	Oracle SQL Forms	LOTUS NOTE
CLIPPER	IEF/COOL:GEN	SQL	C++
IDEAL	ORACLE	Datastage Basic	J2EE

Evidently, there is still a place in the software world for old COBOL programmers

There has also been an increase in “hybrid” projects using, for example, both Java and COBOL as legacy systems are adapted to the Web

Trends over Time
Productivity

Median Productivity				
	1990-1994	1995-1999	2000-2004	2005+
FP/PM	11.10	17.00	9.21	5.84
FP/Mth	17.10	63.90	29.74	22.10
PI	15.3	16.4	13.9	10.95
Size (FP)	394.0	167.0	205	144

Why has productivity decreased?

- Projects are much smaller
- Re-usable components
- Package implementations where the principal work is configuration
- Has the technical complexity of projects increased?

Trends over Time
Schedule and Effort

Median Schedule and Effort				
	1990-1994	1995-1999	2000-2004	2005 -
Duration (Mths)	10.06	6.67	6.57	7.13
Effort (Person Mths)	32.00	26.45	23.0	21.6

- Project duration has been relatively stable since the mid 90's
- Overall project effort has continued to decrease

Recommendations for Improvement

- **Bundle smaller projects together and manage them as a single project**
  - 1/3 of projects are smaller than 100 FP
  - The productivity of projects in the 250 – 300 FP range is nearly twice as high (See slide 8)
- **Relax the schedule**
  - There is a 33% productivity improvement for projects if they move from slight schedule compression (.5 standard deviations below average) to .5 above average. (See slide 14)
- **Staff sparingly**
  - Staffing levels have little impact on schedule; but do impact cost & quality (negatively)

Summary

- Function points have "staying power" and are widely used: principally to count business IT systems
- Project size has decreased and is now half as large as it was 20 years ago
- 75% of function point projects modify existing systems
- Projects deliver faster and expend less effort than they did 20 years ago
- Productivity measured in FP per person month or hours per FP has dropped since the year 2000

Summary

- The factors that have the most pronounced impact on software project productivity and quality are the result of management choices:
  - How much functionality (size) to include in a project
  - Staffing strategy
  - Time and effort allocated to analysis and design
  - Schedule (compressed or relaxed)

Contact Information

- don.beckett@qsm.com
- (360) 638-0097

Supplementary Slides

Project Staffing

Median Schedule Months by Staffing Quartile				
Size (FP)	**Smallest**	**2nd**	**3rd**	**Largest**
<= 100	5.75	6.10	5.90	5.77
101 - 200	6.48	7.10	6.80	6.70
201 - 300	6.85	7.03	7.85	7.07
301 - 500	7.45	6.97	8.22	8.17
501 - 1000	7.77	7.33	8.30	9.10
Larger	7.53	11.03	9.15	11.72

Increased staffing levels do not correlate with shorter schedules

Project Staffing

Average Schedule Months by Staffing Quartile				
Size (FP)	**Smallest**	**2nd**	**3rd**	**Largest**
<= 100	6.44	6.70	6.41	6.47
101 - 200	7.41	7.75	7.71	7.13
201 - 300	8.28	7.86	8.16	8.05
301 - 500	8.45	8.37	8.42	8.77
501 - 1000	9.41	10.09	10.22	9.46
Larger	9.67	12.14	10.62	13.02