Case Example 12:

Simultaneous Changes in Experience, Methods, Languages, and Quality Control

The case examples have been limited to a single key factor. In real life all of these factors can change simultaneously. The table below shows the wide range between best-case results and worst-case results when key factors all change at once; experience, languages, methods, tools, reuse, and work hours. This case shows CMMI levels, languages, experience, and methodologies simultaneously.

Example 12: How Software Risk Master (SRM) Evaluates Multiple Factors Simultaneously

	WORST CASE FACTORS	AVERAGE CASE FACTORS	BEST CASE FACTORS		
	Novice team	Average team	Expert team		
	CMMI 1	CMMI 3	CMMI 5		
	Waterfall	Agile	TSP/PSP		
	C	Java	Objective C		
	0% reuse	15% reuse	75% reuse	Reuse lowers schedules, costs, staffing	
	State government	Insurance	Smart phone	Government software often worst case	
	Poor quality	Average quality	Good quality		
Methodology	Waterfall	Agile	TSP/PSP	TSP = team software process	
				PSP = personal software process	
Size in Function Points.	1000	1000	1000		
Language level	2.50	6.00	12.00	Levels defined by IBM circa 1973	
Source lines per function point	128.00	53.33	26.67	Data available on over 600 languages	
New code in application	128,000	45,333	6,667		
Reused code in application	0	8,000	20,000	Reuse lowers schedules, costs, defects	

Size in Total Lines of Code	128,000	53,333	26,666	High-level languages reduce code	
Complexity	Average	Average	Average		
Work Patterns					
Normal work hours	120	132	160	Work patterns vary by country, industry, company	
Unpaid overtime hours	0	4	20	Unpaid overtime lowers costs, schedules	
TOTAL HOURS PER MONTH	120	136	180		
Project Risks					
Cancellation	64.00%	14.19%	8.92%	Risks vary among methodologies, experience	
Negative ROI	49.00%	18.00%	11.30%		
Cost overrun	57.00%	15.90%	9.82%		
Schedule slip	86.00%	19.30%	11.90%	Schedule slip is most common risk	
Unhappy	23.17%	12.30%	7.14%		
Litigation	33.00%	6.26%	3.93%	Litigation % is high for state government software	
Technical debt/high COQ	32.57%	16.00%	10.03%		
Cyber attacks	19.85%	9.75%	6.11%		
Financial Risk	42.75%	21.00%	13.17%		
High waranty repairs	30.03%	14.75%	9.25%		
Poor	22.39%	11.00%	6.90%		
RISK AVERAGE	**41.80%**	**14.40%**	**8.95%**	Quality strong methodologies have lower risks	

Total Defects in Application	**6,400**	**4,800**	**2,200**	**Agile, waterfall are not "quality strong" methodologies**	
				TSP/PSP are "quality strong" methodologies	
Pre-Test Defect Removal %	**43.00%**	**69.75%**	**93.00%**		
Defects Removed	**2,752**	**3,348**	**2,046**		
Defects Remaining	**3,648**	**1,452**	**154**		
Joint Application Design (JAD)	No	Yes	Yes		
Scrum sessions	No	Yes	Maybe		
Informal reviews	Yes	Yes	No		
Quality function deployment (QFD)	No	No	Yes		
Six Sigma for software	No	No	Maybe		
Requirements inspection	No	No	Yes	**DRE goes up with inspections**	
Design inspection	No	No	Yes		
Code inspection	No	No	Yes		
Test material inspection	No	Maybe	Yes		
Static analysis	No	Maybe	Yes	**DRE goes up with static analysis**	
Test Defect Removal %	**68.00%**	**85.00%**	**92.00%**		
Defects Removed	**2,481**	**1,234**	**142**		
Defects Remaining	**1,167**	**218**	**12**		
Unit test	Yes	Yes	Yes		
Function test	Yes	Yes	Yes		
Regression test	Yes	Yes	Yes		
Performance test	Yes	Yes	Yes		
Component test	No	No	Yes		
System test	Yes	Yes	Yes		
Acceptance/Beta test	Yes	Yes	Yes		

Bad fix injection %	9%	5%	2%	Bad-fix injection is low with quality-strong methodologies	
Bad fixes (new bugs in repairs)	105	11	0		
Defects detected but not repaired					
prior to delivery to customers	125	36	4	Unrepaired defects are low with quality-strong methodologies	
Cumulative Defect Removal %	**81.76%**	**92.30%**	**99.45%**	All projects should top 96% defect removal efficiency (DRE)	
				DRE developed by IBM circa 1973	
Total Defects Removed	5,233	4,582	2,188		
Total Defects Delivered	**1,397**	**265**	**18**		
High-Severity Defects	**196**	**29**	**1**		
Security Flaws Delivered	**26**	**4**	**0**		
Average monthly cost	$10,000	$10,000	$10,000		
OVERALL					
Development Schedule	21.61	10.88	3.90	Government schedules worst of any industry	

Staff (technical + management)	**17**	**11**	**9**		
Development Effort (staff	**371**	**124**	**31**		
Development Costs	**$3,710,000**	**$1,236,000**	**$350,000**		
DEVELOPMENT ACTIVITES					
Requirements Effort (staff months)	16.75	10.48	3.77		
Design effort (staff months)	23.73	14.85	5.35		
Coding effort (staff months)	184.37	44.96	7.70		
Testing effort (staff months)	111.74	31.74	10.26		
Documentation effort (staff month)	5.18	3.24	1.17		
Quality assurance effort	6.47	4.05	1.46		
Management effort (staff months)	22.78	14.26	5.13		
TOTAL EFFORT (Staff months)	**371.00**	**123.58**	**34.84**		
Function points per month	**2.70**	**8.09**	**28.70**		
Work hours per FP	**48.97**	**16.81**	**4.60**		
LOC per month	**143.75**	**431.56**	**1530.76**		
Total Cost of Development	**$3,710,000**	**$1,235,000**	**$350,000**		
Total Cost of Maintenance	**$3,777,000**	**$775,000**	**$125,000**	**Maintenance is cheaper with quality-strong methodologies**	
Total Cost of Enhancement	**$650,000**	**$375,000**	**$222,000**		
TOTAL COST OF OWNERSHIP (TCO)	**$8,137,000**	**$2,385,000**	**$1,026,660**	**TCO is cheaper with quality-strong methodologies**	

TCO $ per Function Point	**$8,137.00**	**$2,385.00**	**$1,026.66**		
% of average	**341.17%**	**100.00%**	**43.05%**		
% of average schedules	**198.62%**	**100.00%**	**35.85%**		
% of average delivered	**527.95%**	**100.00%**	**6.80%**		
		END OF EXAMPLE			
Countries	**Industries**		**Methodologies**		**Languages**
Best Quality	**Best Quality**		**Best quality**		**Best quality**
Japan	Manufacturing - medical devices		Robotic development with 99% standard parts		IntegraNova
India	Manufacturing - aircraft		Reuse-oriented (85% reusable materials)		Excel
Finland	Government - military		Animated, 3D, full color design development		BPM
Switzerland	Smartphone/tablet applications		Pattern-based development		Generators
Denmark	Government - intelligence		Virtual reality global development		Mathematica10
Israel	Software (commercial)		T-VEC development		Mathematica9
Sweden	Telecommunications operations		IntegraNova development		TranscriptSQL
Netherlands	Manufacturing - defense		Kaizen development		QBE

Hong Kong	Manufacturing - telecommunications		Container development (65% reuse)		X
Good Quality	Process control and embedded		Model-driven development		TELON
Brazil	Manufacturing - pharmaceuticals		**Good Quality**		APS
Singapore	Professional support - medicine		Clean room development		Forte
United Kingdom	Transportation - airlines		Team software process (TSP) + PSP		MUMPS
Malaysia	Manufacturing - electronics		Feature driven (FDD)		IBM ADF
Norway	**Good Quality**		Personal software process (PSP)		Smalltalk
Taiwan	Banks - commercial		Specifications by Example		Eiffel
Canada	Entertainment - films		CMMI development		ASP NET
Ireland-south	Manufacturing - automotive		Micro service development		Objective C
Korea - South	Manufacturing - chemicals		Evolutionary Development (EVO)		Visual Basic
United States	Manufacturing - appliances		Rational Unfied Process (RUP) from IBM		Good Quality
Hungary	Insurance - Life		Prototypes - disposable		Delphi
Mexico	Banks - investment		Open-source development		APL
Australia	Software (outsourcing)		Object Oriented (OO) development		Julia
Austria	Insurance - property and casualty		Global 24 hour development		M
Peru	Pharmacy chains		Disciplined agile delivery (DAD)		OPA
Belgium	Government - police		Product Line engineering		Pearl
Luxembourg	Insurance - medical		Service-Oriented modeling		Elixir

Spain	Open source development		Mashup development		Haskell
France	Social networks		**Average quality**		Mixed Languages
Average Quality	Games - computer		Prototypes - evolutionary		DB2
Germany	Entertainment - television		Information engineering (IE)		LiveScript
Phillipines	Transportation - trains		Crystal development		Oracle
Czech Republic	Public utilities - electricity		Extreme programming (XP)		**Good Quality**
Ireland-north	Public utilities - water		Pair programming development		Erlang
New Zealand	Accounting/financial consultants		Lean development		CICS
Thailand	Professional support - law		Microsoft solutions		DTABL
South Africa	Credit unions		Spiral development		F#
Italy	Manufacturing - nautical		GIT development		Ruby
Poland	Transportation - bus		Legacy renovation		Simula
Kuwait	Sports (pro baseball, football, etc.)		Legacy replacement development		Dart
Costa Rica	**Average Quality**		Iterative development		RPG III
Bolivia	Publishing (books/journals)		Test-driven development (TDD)		Ada 95
Estonia	Manufacturing - apparel		CASE development		Ceylon
Chile	Hospitals - administration		Hybrid (agile + waterfall)		Fantom
Panama	Transportation - ship		Agile + scrum		C#
Argentina	Consulting		Legacy repair development		X10
China	Real estate - commercial		Structured development		C++
Iceland	Oil extraction		Continuous development		Go
Cuba	Entertainment - music		Dynamic system development method (DSDM)		Java

Bahrain	Other industries		**Poor quality**		PHP
Ukraine	Natural gas generation		DevOps development		Python
Venezuela	Automotive sales		Legacy data mining		Zimbu
Portugal	Games - traditional		Prince 2 development		Quick Basic
Indonesia	Wholesale		Merise development		Basic (interpreted)
Viet Nam	Education - University		Agile/Scrum		Forth
Jordan	Government - municipal		Rapid application development (RAD)		haXe
Tunesia	Hotels		Reverse engineering		Lisp
Colombia	**Poor Quality**		V-Model development		Prolog
Saudi Arabia	Government - state		Reengineering		SH (shell scripts)
Bangladesh	Government - county		Cowboy development		**Poor quality**
Greece	Retail		ERP modification development		ESPL/I
Algeria	Stock/commodity brokerage		Waterfall development		Javascript
Turkey	Automotive repairs		COTS Modifications		ABAP
Lebanon	Real estate - residential		Anti patterns		Modula
Poor Quality	Education - primary				PL/I
Syria	Education - secondary				Pascal
Pakistan	Manufacturing - general				PL/S
Libya	Construction				GW Basic
Iraq	Mining - metals				Algol
Burma	ERP vendors				Bliss
Korea - North	Agriculture				Chill
Russia	Waste management				COBOL
Iran	Transportation - truck				Coral
	Government - federal civilian				Fortran
	Mining-coal				Jovial
	Food - restaurants				C

					XML
					HTML
					Macro Assembly
					JCL
					Basic Assembly
					Machine language
					English text