
# When use COSMIC FFP?
# When use IFPUG FPA?

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# Dr. Thomas Fehlmann

- 1981: Dr. Math. ETHZ
  - Mathematical Logic, Combinatory Logic
- 1982-89: Manager SW Development
- 1990-95: Senior Consultant – Project Office
- 1996-99: Proposal Center Manager
- 1999ff: Euro Project Office AG, Zürich
  - Project Management, Coaching & Support
  - SwiSMA: Software Metrics, Function Points, COSMIC FFP
  - Akao Price 2001
  - Board Member QFD Institute Deutschland – QFD Architect
  - Six Sigma Black Belt for GMC Software AG

# Agenda

- **What is Six Sigma? What is Software?**
- Which is the best Counting Approach?
- Aligning Business with Technical Requirements

# What is Six Sigma?

Six Sigma

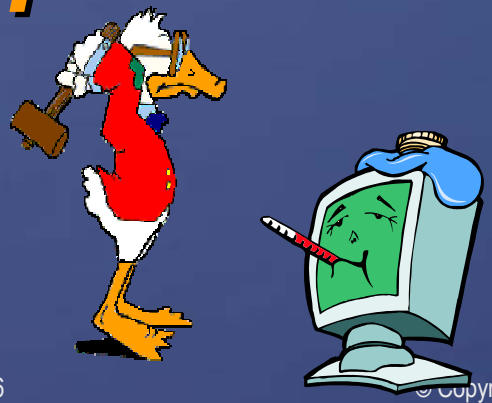
1. Customer's Needs
2. Process – Orientation
3. Lead with Metrics

- Eliminate Defects
  - Reducing cost of defects
  - Improving customer satisfaction

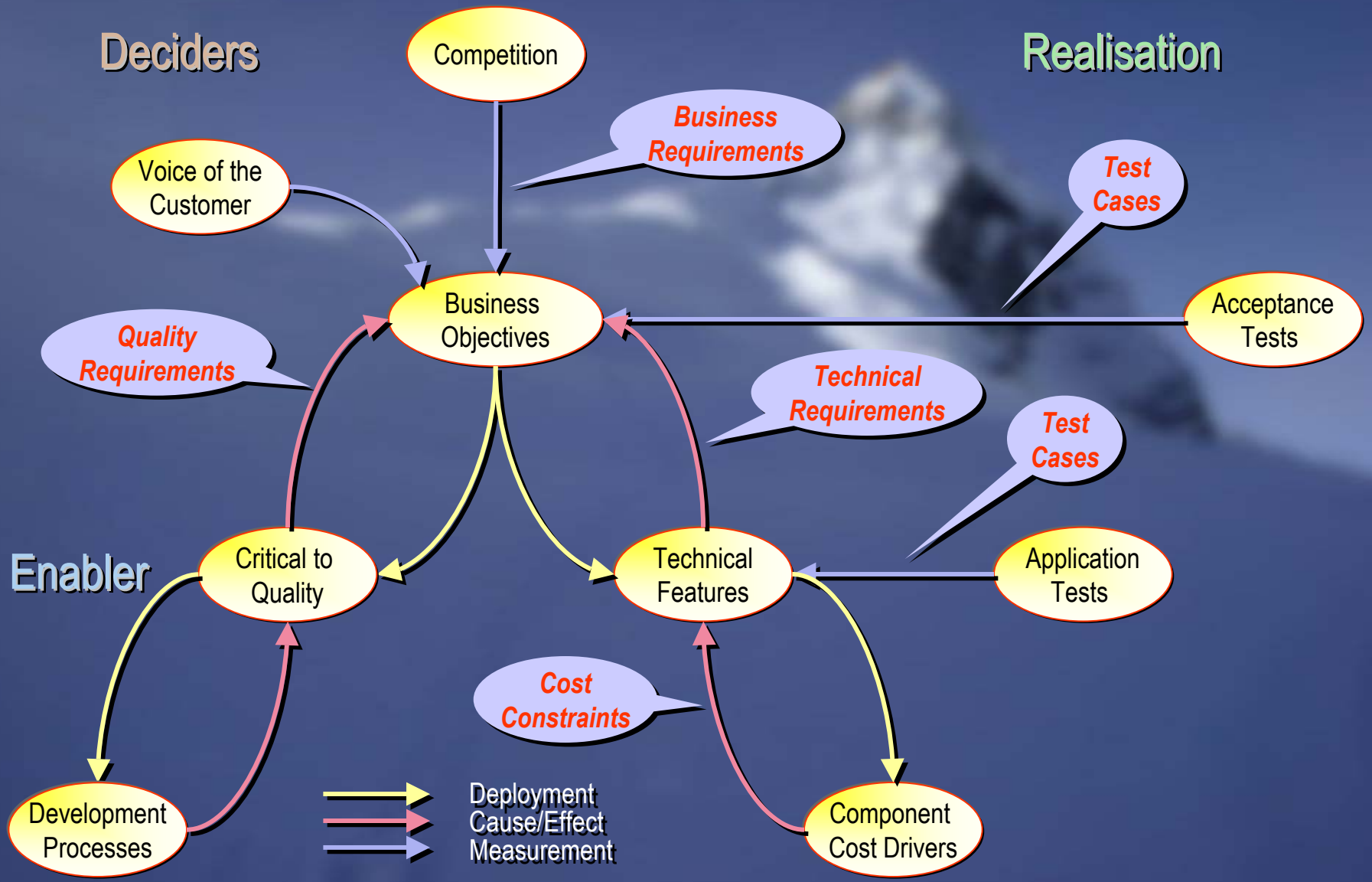
➢ ***Improve Business Results!***

# What is Software?

- Software is Knowledge Acquisition!
- A defect in software is:
  - ***Business requirement not understood!***
  - ***Customer's expectation missed***



# Software Requirements Model

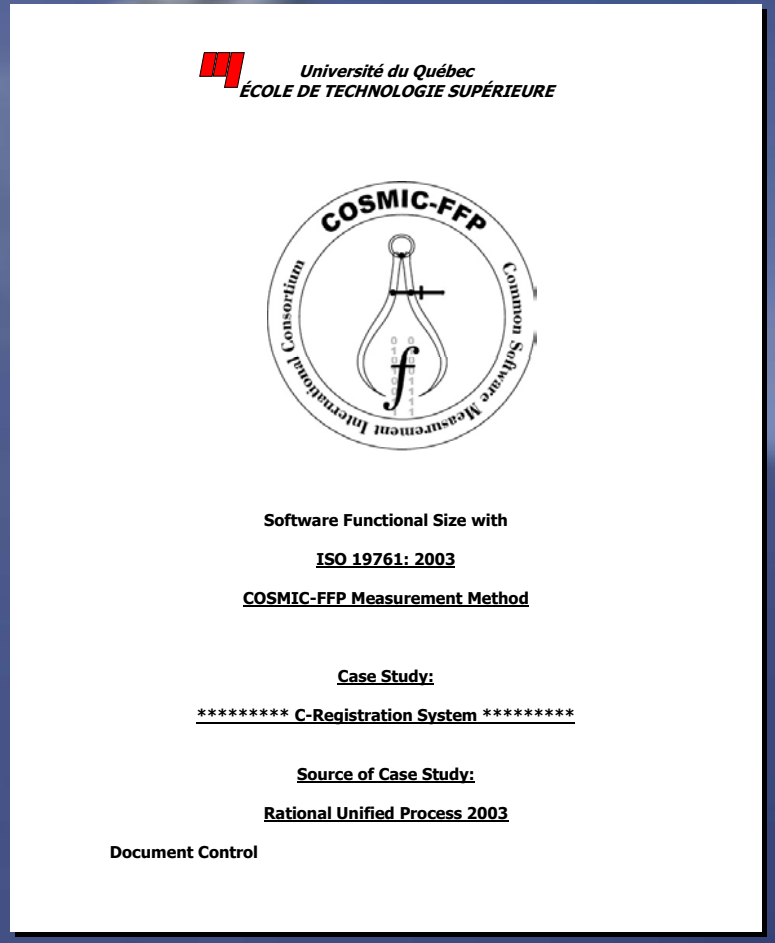


# Agenda

- What is Six Sigma? What is Software?
- **Which is the best Counting Approach?**
- Aligning Business with Technical Requirements

# Wylie College C-Registration System

- The Wylie College course registration system case study is documented in the Rational Unified Process (RUP Version 2003.06.00.65) as an example of Web site project
- It was counted in a paper published by Khelifi and Abran, University of Québec, using COSMIC FFP



*Université du Québec*
*ÉCOLE DE TECHNOLOGIE SUPÉRIEURE*

COSMIC-FFP

Software Functional Size with

ISO 19761: 2003

COSMIC-FFP Measurement Method

Case Study:

********* C-Registration System *********

Source of Case Study:

Rational Unified Process 2003

Document Control

# Wylie College
# Business Requirements

- The new system will enable all professors and students to access the system through PCs connected to the Wylie College computer network and through any personal computer connected through the Internet
- Furthermore, the new system will bring the Wylie College to the leading edge in course registration systems thus improving the image of the College, attracting more students, and streamlining administrative functions

# Technical Requirements
# 16 Use Cases

- 1.1 Logon
- 1.2 Close Registration
- 2.1 Add a professor
- 2.2 Modify a professor
- 2.3 Delete a Professor
- 3.1 Create a Schedule
- 3.2 Modify a Schedule
- 3.3 Delete a Schedule
- 3.4 Save a Schedule
- 4.1 Add a student
- 4.2 Modify a student
- 4.3 Delete a Student
- 4.4 Select Courses to Teach
- 4.5 Submit Grades
- 4.6 View Report Card
- 4.7 Monitor for Course Full

# Use Case Count using COSMIC

| No | Process ID | Process Description | Sub-Process FFP | | | | Points FFP (Cfsu) |
|---|---|---|---|---|---|---|---|
| | | | E | X | R | W | |
| 1 | 1.1 | Logon | 1 | 3 | 1 | 0 | 5 |
| 2 | 1.2 | Close Registration | 1 | 4 | 3 | 3 | 11 |
| 3 | 1.3 | Add a professor | 3 | 4 | 1 | 1 | 9 |
| 4 | 1.4 | Modify a professor | 4 | 4 | 1 | 1 | 10 |
| 5 | 1.5 | Delete a Professor | 5 | 5 | 1 | 1 | 12 |
| 6 | 1.6 | Create a Schedule | 2 | 3 | 2 | 3 | 10 |
| 7 | 1.7 | Modify a Schedule | 2 | 3 | 3 | 3 | 11 |
| 8 | 1.8 | Delete a Schedule | 2 | 3 | 1 | 1 | 7 |
| 9 | 1.9 | Save a Schedule | 1 | 1 | 0 | 2 | 4 |
| 10 | 1.10 | Add a student | 3 | 4 | 1 | 1 | 9 |
| 11 | 1.11 | Modify a student | 4 | 4 | 1 | 1 | 10 |
| 12 | 1.12 | Delete a Student | 5 | 5 | 1 | 1 | 12 |
| 13 | 1.13 | Select Courses to Teach | 2 | 3 | 2 | 3 | 10 |
| 14 | 1.14 | Submit Grades | 2 | 3 | 2 | 1 | 8 |
| 15 | 1.15 | View Report Card | 1 | 3 | 1 | 0 | 5 |
| 16 | 1.16 | Monitor for Course Full | 1 | 1 | 1 | 1 | 4 |
| **Total:** | | **16 Processes** | **39** | **53** | **22** | **23** | **137** |

PDR = 10.2 hours/Csfu → 1'397 hours

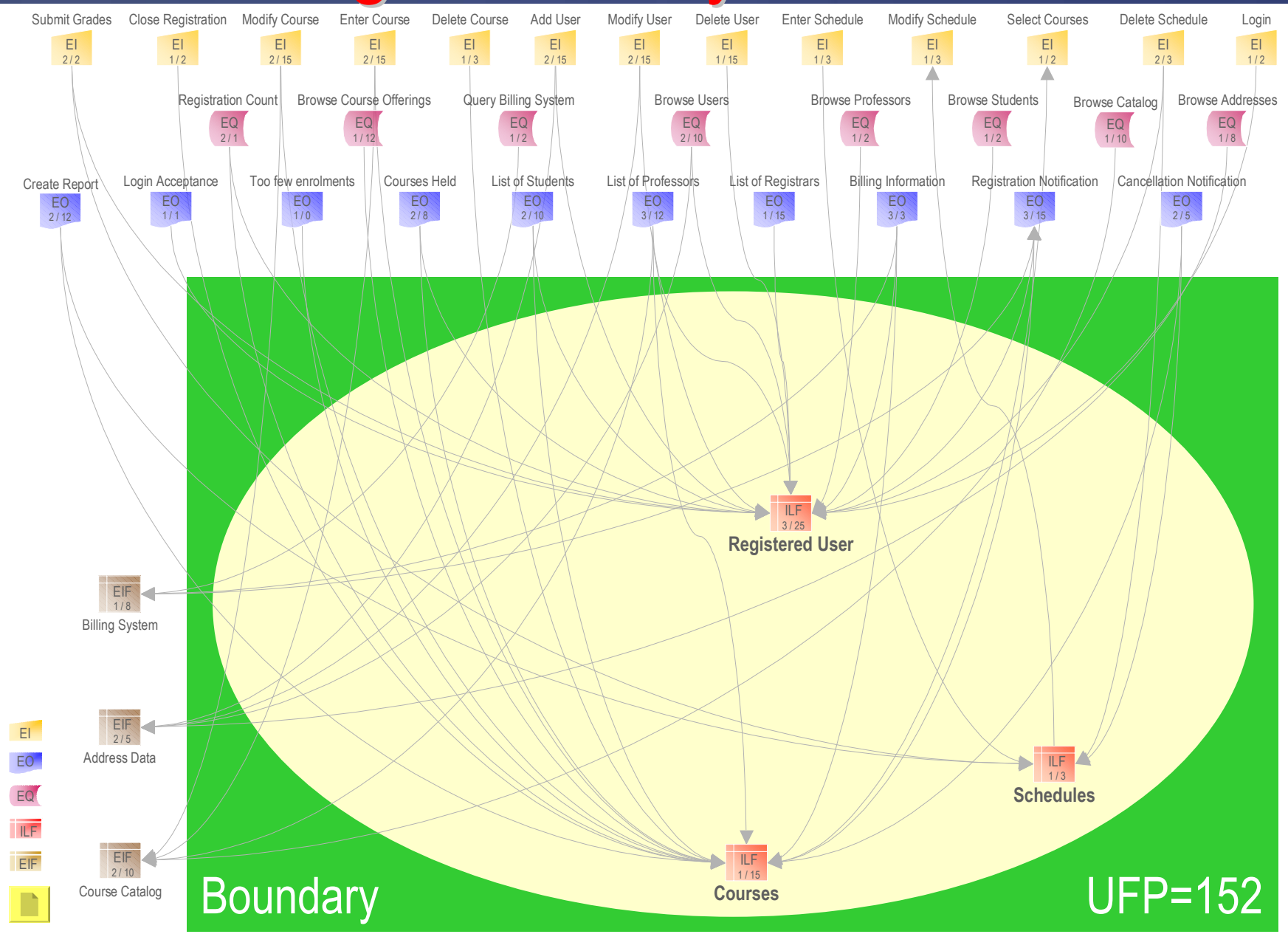
# Findings

- The following ambiguities have been noted:
  - In the ‘Close Registration’ use case specifications there’s an issue stated by the authors ‘Need to resolve what to do if too few students registered for a course’.
- For this measurement, the following assumptions were made:
  - Add the ‘Monitor for Course Full’ functional process in order to resolve it and to have a more accurate measure.
- ***We’ve found a missing technical requirement!***

# Functional Sizing with IFPUG

- Transactions
  - EI:  External Input
  - EO: External Output
  - EQ: External Query
- Data
  - ILF: Internal Logical Files
  - EIF: External Interface Files

# C-Registration System Count



# Findings

- It matters, whether we take one ILF “Registered Users” with 3 RETs; or three ILFs for Students, Professors, and Registrars
  - Can a professor register for a course?
  - Overall count affected!
- Where are the user’s addresses?
  - Missing requirement!
- Numerous reports detected
  - They were not specified!
- ***We’ve found missing business requirements!***

# ISBSG R9 Estimation

International Software Benchmarking Standards Group

**International Software Benchmarking Standards Group**
**Comparative Estimating Tool V4.0**
based upon ISBSG Estimating, Benchmarking & Research Suite Release 9, 2004

**Inputs**

**Filters**

Functional size (function points):
0 - 500

Development platform:
Match all

VAF = 1

**Parameter**

Functional size (function points):
152

Range minimum (percentile):
25

Range maximum (percentile):
75

Estimate

Reset

**Developed in conjunction with** CHARISMATEK SOFTWARE METRICS

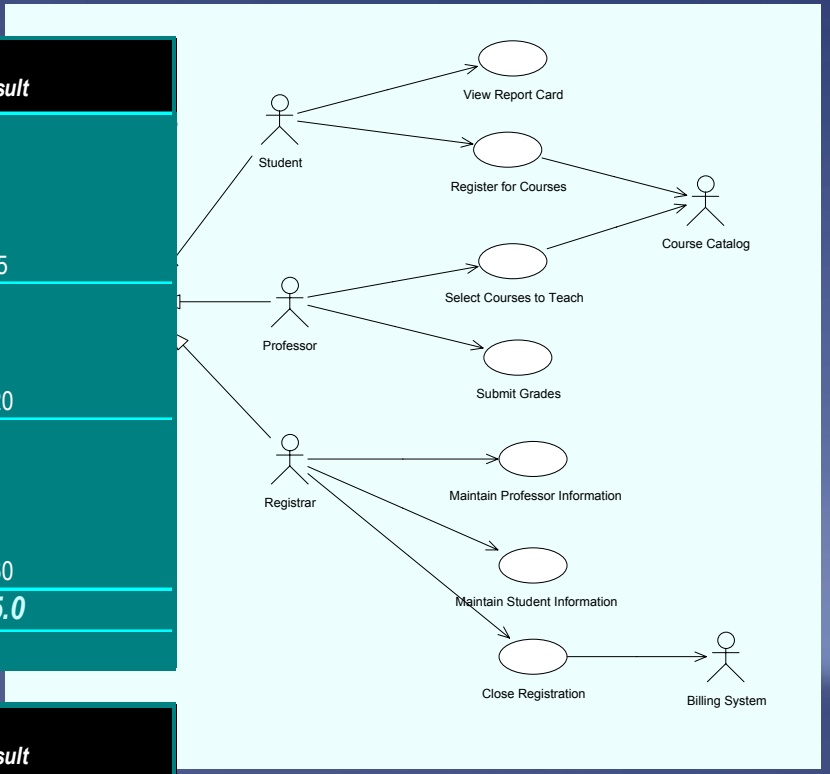
| Project attributes | | Number of matches | Project Delivery Rate Optim 25 % | Project Delivery Rate Likely Median | Project Delivery Rate Conserv 75 % | Speed of Delivery Conserv 25 % | Speed of Delivery Likely Median | Speed of Delivery Optim 75 % |
|---|---|---|---|---|---|---|---|---|
| Business area type: | Administration | 0 | | | | | | |
| Application type: | Catalogue/Register of Things or Eve | 2 | 26.7 | 35.8 | 44.9 | 11.2 | 17.2 | 23.1 |
| Maximum team size: | 1 | 3 | 3.5 | 3.6 | 3.8 | 25.0 | 29.9 | 30.5 |
| Language type: | 3GL | 33 | 6.3 | 10.5 | 20.2 | 29.1 | 41.0 | 63.1 |
| Primary programming language: | 3GL | 1 | 7.5 | 7.5 | 7.5 | 23.4 | 23.4 | 23.4 |
| User base - business units: | > 5 | 3 | 4.1 | 4.1 | 5.0 | 34.7 | 34.7 | 34.7 |
| User base - locations: | 1 | 6 | 3.7 | 5.2 | 9.6 | 29.9 | 60.0 | 60.3 |
| User base - concurrent users: | > 5 | 17 | 5.5 | 10.5 | 12.3 | 25.0 | 37.0 | 51.9 |
| Used CASE: | Yes | 11 | 4.5 | 5.9 | 9.6 | 27.8 | 29.2 | 59.6 |
| Used methodology: | Yes | 37 | 4.5 | 10.4 | 15.1 | 28.5 | 38.0 | 60.2 |
| How methodology acquired: | Combined Developed / Purchased | 0 | | | | | | |
| Architecture: | Multi Tier | 0 | | | | | | |
| Web development: | Yes | 19 | 3.4 | 7.0 | 9.7 | 46.8 | 60.0 | 99.9 |

| Estimates<br>Level 1 - Dev Team | Project Delivery Rate<br>*(hours per function point)* | Project Work Effort<br>*(hours)* | Speed of Delivery<br>*(function points per month)* | Project Duration<br>*(months)* |
|---|---|---|---|---|
| **Optimistic** | 7.0 | 1'059 | 50.7 | 3.0 |
| **Likely** | 10.1 | 1'528 | 37.0 | 4.1 |
| **Conservative** | 13.8 | | 28.2 | 5.4 |

PDR = 10.1 hours/FP→ 1'528 hours

# Unadjusted Use Case Points

| Use Case Type | Description | Weight | No of Use Cases | Result |
|---|---|---|---|---|
| Simple | A simple user interface and touches only a single database entity; its success scenario has 3 steps or less; its implementation involves less than 5 classes. | 5 | 1 | 5 |
| Average | More interface design and touches 2 or more database entities; between 4 to 7 steps; its implementation involves between 5 to 10 classes. | 10 | 2 | 20 |
| Complex | Involves a complex user interface or processing and touches 3 or more database entities; over seven steps; its implementation involves more than 10 classes. | 15 | 4 | 60 |
| | UUCW | | | 85.0 |




| Actor Type | Description | Weight | No of Actors | Result |
|---|---|---|---|---|
| Simple | The Actor represents another system with a defined API. | 1 | 1 | 1 |
| Average | The Actor represents another system interacting through a protocol, like TCP/IP | 2 | 1 | 2 |
| Complex | The Actor is a person interacting via an interface. | 3 | 4 | 12 |
| | UAW | | | 15.0 |

| | |
|---|---|
| Total Unadjusted Use Case Points | 100.0 |

# Use Case Count

| | | |
|---|---|---|
| TCF | Technical Complexity Factor | 1.01 |
| ECF | Environmental Complexity Factor | 0.83 |
| UUCP | Unadjusted Use Case Points | 100 |
| PF | Productivity Factor | 20 |
| | *Total Expected Effort* | *1'668 Hours* |

# Preliminary Conclusions

- IFPUG FPA for early measurement of business requirements
  - Detects missing business requirements
  - Valuable basis for quick and early estimation
- COSMIC FFP takes technical approach into account
  - Requires Structure Diagrams
  - Detects missing technical requirements
  - Recommended for engineering
  - Convergence factor links FFP to FPA metrics
- Use Case Points measure the Use Case diagram only
  - Depends from level of granularity
- ***How do we know we got all Use Cases???***

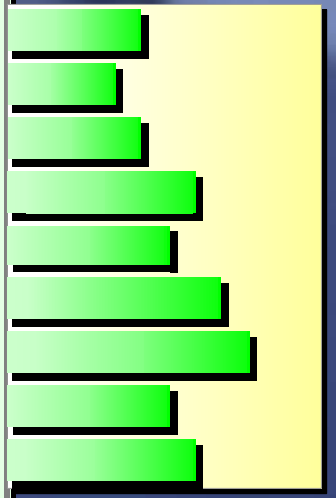
# Agenda

- What is Six Sigma? What is Software?
- Which is the best Counting Approach?
- **Aligning Business with Technical Requirements**

# Wylie College Business Needs

***Business Objectives Profile***

| | Business Objectives | Combined Profile | Expert Evalution |
|---|---|---|---|
| **BO-1 Functional** | BO-1.1 Students register for courses on-line | *1.3* | *5* |
| | BO-1.2 Professors select their teaching courses | *1.0* | *4* |
| | BO-1.3 Professors maintain student grades | *1.3* | *5* |
| | BO-1.4 Access the system through Internet | *1.8* | *7* |
| | BO-1.4 Only browser is needed to use the system | *1.5* | *6* |
| **BO-2 Quality** | BO-2.1 Leading edge in course registration systems | *2.0* | *8* |
| | BO-2.1 Improve the image of the College | *2.3* | *9* |
| | BO-2.2 Attract more students | *1.5* | *6* |
| | BO-2.3 Streamline administrative functions | *1.8* | *7* |



# COSMIC Functional Processes

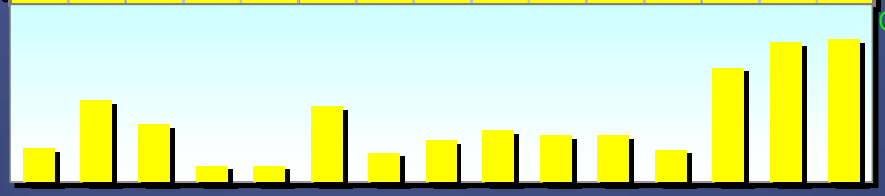
| | *Topics* |
|---|---|
| **FP-1 Administration** | FP-1.1 Logon |
| | FP-1.2 Close Registration |
| **FP-2 Maintain Professor Information** | FP-2.1 Add a professor |
| | FP-2.2 Modify a professor |
| | FP-2.3 Delete a Professor |
| **FP-3 Register for Courses** | FP-3.1 Create a Schedule |
| | FP-3.2 Modify a Schedule |
| | FP-3.3 Delete a Schedule |
| | FP-3.4 Save a Schedule |
| **FP-4 Maintain Student Information** | FP-4.1 Add a student |
| | FP-4.2 Modify a student |
| | FP-4.3 Delete a Student |
| | FP-4.4 Select Courses to Teach |
| | FP-4.5 Submit Grades |
| | FP-4.6 View Report Card |
| | FP-4.7 Monitor for Course Full |

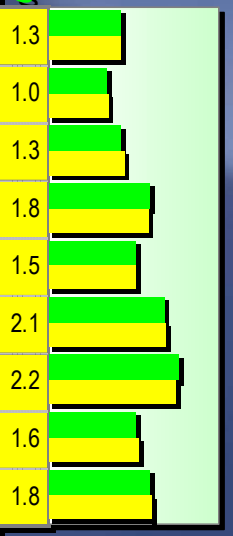
# Quality Function Deployment

**Functional Processes Deployment Combinator**

**Functional Processes**

| Business Objectives | | Goal Profile | FP-1.1 Logon | FP-1.2 Close Registration | FP-2.1 Add a professor | FP-2.2 Modify a professor | FP-2.3 Delete a Professor | FP-3.1 Create a Schedule | FP-3.2 Modify a Schedule | FP-3.3 Delete a Schedule | FP-3.4 Save a Schedule | FP-4.1 Add a student | FP-4.2 Modify a student | FP-4.3 Delete a Student | FP-4.4 Select Courses to Teach | FP-4.5 Submit Grades | FP-4.6 View Report Card | Effective Profile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | 0.04 |
| BO-1.1 | Students register for courses on-line | 1.3 | 3 | 9 | | | | 9 | 9 | 3 | 9 | | 9 | | | | | 1.3 |
| BO-1.2 | Professors select their teaching courses | 1.0 | 3 | | 9 | 3 | 3 | | | | | | | | 9 | | 3 | 1.0 |
| BO-1.3 | Professors maintain student grades | 1.3 | 9 | | 9 | 3 | 3 | | 3 | | 3 | | | | | 9 | 9 | 1.3 |
| BO-1.4 | Access the system through Internet | 1.8 | 9 | 3 | | | | 1 | | | 9 | | | | 9 | 9 | 9 | 1.8 |
| BO-1.4 | Only browser is needed to use the system | 1.5 | | 3 | | | | 1 | | | | 9 | 9 | 9 | 3 | 9 | 9 | 1.5 |
| BO-2.1 | Leading edge in course registration systems | 2.0 | | 1 | 9 | 3 | 3 | 9 | 3 | 3 | | 9 | 3 | 3 | 9 | 9 | 9 | 2.1 |
| BO-2.1 | Improve the image of the College | 2.3 | 3 | 9 | 3 | | | 9 | | 3 | | 3 | | | 9 | 9 | 9 | 2.2 |
| BO-2.2 | Attract more students | 1.5 | | 3 | | | | 3 | | | 3 | | | | 9 | 9 | 9 | 1.6 |
| BO-2.3 | Streamline administrative functions | 1.8 | 1 | 9 | | | | 1 | 1 | 9 | 3 | 3 | 3 | 3 | | 9 | 9 | 1.8 |
| | Solution Profile for Functional Processes | | 0.6 | 1.4 | 1.0 | 0.3 | 0.3 | 1.3 | 0.5 | 0.7 | 0.9 | 0.8 | 0.8 | 0.5 | 1.9 | 2.3 | 2.4 | |





Convergence Factor
0.04

0.1 Convergence Range
0.3 Convergence Limit

# Measure how well you meet the requirements with your solution

- ***Convergence Factor $\kappa$***

$$\kappa = \frac{|z - x|}{\sqrt{m}} = \sqrt{\frac{\sum_{j=1..m} (\zeta_j - \xi_j)^2}{m}}$$

  - A Six Sigma metric for expected deviation
  - Describes deviation between profiles of
    - Business Requirements $z$
    - Technical Requirements $x$
- Demonstrates how good the solution is

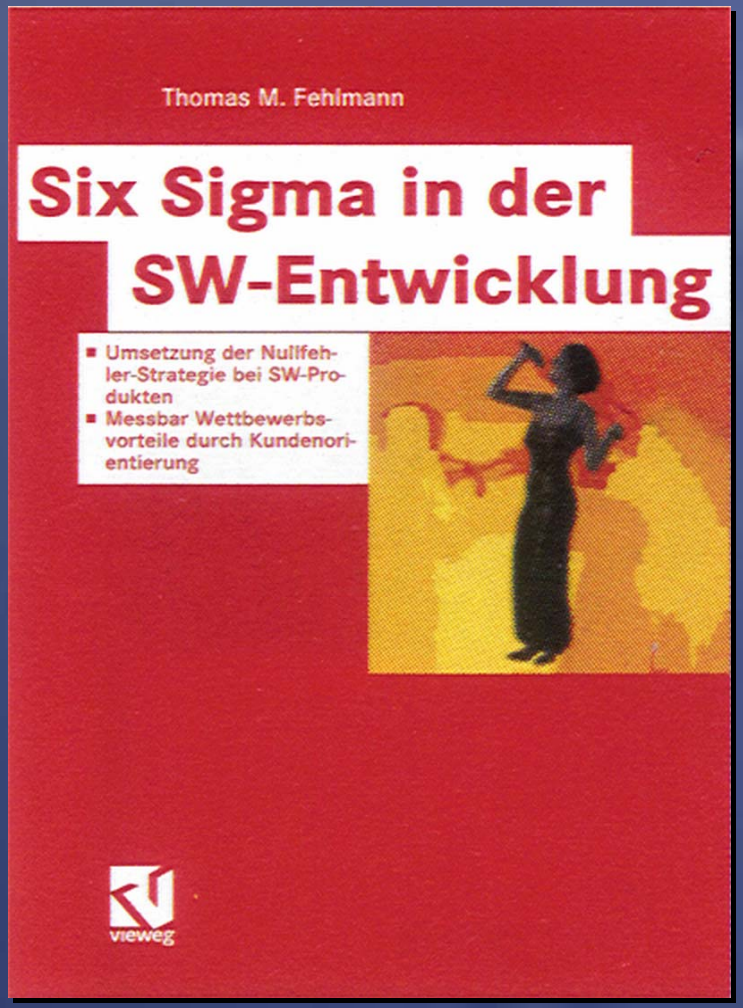
# Results

- The Combinatory Metrics profile complements functional sizing measurements
  - There is no single conversion factor that holds for all kind of FFP or FPA counts within an application area
  - Conversion between FFP and FPA is rather a linear mapping function hat depends from the relationship matrix between business and technical requirements.
- The Quality Function Deployment method generates that linear mapping between business requirements and technical requirements

# Results (cont.)

- Sizing Measurement is Requirements Measurement
  - Late deliveries, called B-defects, and missing requirements, typical A-defects, are related to each other
  - Measuring functional size of both business requirements and technical requirements avoids concentrating development efforts on wrong priorities
  - If the convergence factor is right!
- The clue for success are measurements
  - Do both: IFPUG and COSMIC

# Six Sigma for SW Development




- In German
- 1st edition August 2005, Vieweg-Verlag, Wiesbaden
  - Explains zero defect strategy for A-defects and B-defects
  - Edited by Prof. Rainer Bischoff

# Questions?