Project Management

Jan Hornwall, Director Project Management, Siemens PLM Software
Key Objectives of this Lecture

• You know more about the Project Management areas

• We have looked at some Best Practices in Project Management

• We have had a discussion on working in software development projects and managing projects
Agenda

• Introduction of the Speaker & Siemens PLM Software

• Introduction to Projects and Project Management

• The Project Management Knowledge Areas and Processes
  • including best practices

• Discussion on main challenges with working in projects and together with a Project Manager

• Key Take Aways
Introduction of the Speaker

• From Sweden, living in Switzerland since 1992
• Master of Science in Physics Engineering, Chalmers University, Gothenburg
• Background as Software Engineer in Telecom; Unix, C++
• Working internationally in Project-, Program- and Team management since 1994
• In current role as Director Project Management, Siemens PLM Software since 2007
• Certified Project Management Professional by PMI & Senior Project Manager IPMA
• Founder of PMI chapter Switzerland (www.pmi-switzerland.ch)

• Privately:
  • Family: proud father of three lovely daughters, aged 24, 22 and 4
  • Passionate ski mountaineer, windsurfer, mountain biker and Lindy Hop dancer

Email: jan.hornwall@siemens.com
LinkedIn: www.linkedin.com/in/jan-hornwall

Please feel free to contact me for any questions on this material or any other Project Management questions!
<table>
<thead>
<tr>
<th>Product Engineering</th>
<th>Lifecycle Collaboration</th>
<th>Simulation &amp; Test</th>
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<tbody>
<tr>
<td>NX</td>
<td>Teamcenter</td>
<td>LMS</td>
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<tr>
<th>Manufacturing Engineering</th>
<th>Mainstream Engineering</th>
<th>Specialized Engineering</th>
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<tr>
<td>Tecnomatix</td>
<td>Solid Edge</td>
<td>Vistagx</td>
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### AEROSPACE
- ATK
- AVIC
- BAE Systems
- B/E Aerospace
- Boeing
- CE
- General Dynamics
- Goodrich
- Honeywell
- L3 Communications
- Lockheed Martin
- NASA & JPL
- Rafael
- Rolls-Royce
- Space Systems Loral
- SpaceX
- United Aircraft Corporation
- ULA
- United Technologies
- USAF

### AUTOMOTIVE
- Autocar
- BMW
- Chrysler
- Daihatsu
- Daimler
- Delphi
- Fiat
- Ford
- GM
- Hyundai
- Isuzu
- Magna
- Mazda
- Nissan
- Renault
- Suzuki
- Tata
- Volkswagen
- Volvo
- Visteon

### CONSUMER
- Anheuser Busch
- Boots
- Delta
- Dr. Martens
- Estée Lauder
- General Mills
- Keurig Green Mountain
- Kraft
- Lego
- L’Oreal
- Nike
- Procter & Gamble
- PZ Cussons
- RJ Reynolds
- The Jones Group
- Tiffany & Co.
- Toys R Us
- Unilever

### ELECTRONICS
- ASML
- Applied Materials
- B/S/H
- Emerson
- Ericsson
- Fujitsu
- H3C
- Haier
- Hauer
- Lam Research
- LG Electronics
- Mettler-Toledo
- Microsoft
- Philips
- Ricoh
- Samsung
- Seagate
- Teradyne
- Siemens
- Xerox

### ENERGY
- Alstom
- Areva Nuclear
- Baker Hughes
- Balfour Beatty
- China Nuclear
- Con Ed
- FMC
- GE Oil & Gas
- Max Boegl
- Mitsubishi
- NOV
- Nuclear Waste Mgmt
- Siemens Energy
- Toshiba

### MACHINERY
- Allc
- Caterpillar
- DMG
- FMC
- GROB
- Heidelberg
- Hitachi
- Husky
- Hyundai
- JCB
- John Deere
- KBA
- Kone Cranes
- MANNROLAND
- Mori Seiki
- Sany
- Windmoeller & Hoelscher
- Yuchai Group
- Yarmar
- Zoomlion

### MARINE
- BAE Systems Maritime
- Damen Group
- DSME
- Feadship
- Fincantieri
- Flensburger
- GE Electric Boat
- HHI
- HII
- Japan Marine United
- Jiangnan Shipyard
- Lürssen
- MAN Diesel
- Newport News Shipbuilding
- Rolls Royce Marine
- Royal IHC
- Schichau-Gesellschaft
- SHI
- Siemens
- TKMS
- Wartsila

### MEDICAL
- 3M
- Abbott
- Baxter
- Biomet
- Carefusion
- Edwards
- Lifesciences
- Exactech
- Hillrom
- Hitachi
- Johnson & Johnson
- Medin
- Olympus
- Siemens Healthcare
- Smith & Nephew
- St Jude Medical
- Symmetry Medical
- Topcon
- Waldemar Link
- Zimmer
Product Lifecycle Management
Spanning the lifecycle from concept of a product to retirement
### PwC Global 100 Software Leaders (2016)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
<th>Country HQ</th>
<th>2014 Software revenue (US$M)</th>
<th>2014 Total revenue (US$M)</th>
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<td>Adobe</td>
<td>USA</td>
<td>$4,061</td>
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<td>USA</td>
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<td>USA</td>
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<td>Cisco Systems</td>
<td>USA</td>
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<td>Dassault Systèmes</td>
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<td>$2,695</td>
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<td>Apple</td>
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<td>$2,110</td>
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https://www.pwc.com/gx/en/industries/technology/publications/global-100-software-leaders.html
Trends in our Market

**Development Production**

<table>
<thead>
<tr>
<th>In the past:</th>
<th>8 Years</th>
<th>11 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Now:</td>
<td>3 Years</td>
<td>6-8 Years</td>
</tr>
</tbody>
</table>

IoT = Internet of Things

SaaS = Software as a Service

Outcome Engineering

Industry 4.0

Digitalization

Digital Twin

Additive Manufacturing (3D Printing)
Introduction to Project Management

• What is a Project?
  
  A project is a temporary endeavor to create a unique product, service or result. (PMI)

• Why Project Management?
  
  • Almost all software products are obtained via projects, as opposed to manufactured products.
  • Enterprise Software is deployed and customized to customer business through projects

• The challenge with many projects is to manage the “triple constraints”:
  
  - Deliver on time
  - Deliver within budget
  - Deliver agreed functionality to agreed quality = performance
Introduction to Project Management

• What is a Program?
  A group of related projects and program activities that are managed in a coordinated way to obtain benefits not available from managing them individually (PMI)

• What is not a project or a program?
  Examples:
  • Monthly magazine
  • Maintenance / bug fixing of released product
  • Yearly contract for manage data servers
Introduction to Project Management

A typical lifecycle of a Project:

- Stress level of the Project Manager

![Diagram showing the lifecycle of a project with stages such as project charter, project management plan, carrying out the work, and closing the project. The graph also illustrates the cost and staffing level over time.]
The Project Management Knowledge Areas & Processes

Project Management Institute (PMI) is the world's leading not-for-profit professional membership association for the project, program and portfolio management profession. Founded in 1969. It publishes PMBOK Guide. Over 700’000 members world wide.

We will today review:

The Project Management Processes

The Project Management Knowledge Areas:

1. Project Integration Management
2. Project Scope Management
3. Project Schedule Management
4. Project Cost Management
5. Project Quality Management
6. Project Resources Management
7. Project Communications Management
8. Project Risk Management
9. Project Procurement Management
10. Project Stakeholder Management
The 5 main process areas are:
Agile Methods follows the same principle

The Agile: Scrum Framework at a glance

Inputs from Executives, Team, Stakeholders, Customers, Users

Product Owner
The Team

Product Backlog
Sprint Planning Meeting

Ranked list of what is required: features, stories, ...
Team selects starting at top as much as it can commit to deliver by end of Sprint

Sprint Backlog

Task Breakout

Sprint end date and team deliverable do not change

Scrum Master

Burndown/up Charts

Every 24 Hours

Daily Scrum Meeting

Sprint Review

Finished Work

Sprint Retrospective
Let’s Start with Your Project

• This year we will build a 'Job Portal' as a web application where external companies can post their job offers, and university students can apply subsequently to those job postings.

• Students/participants will be divided into small groups (each group will have roughly 3-4 students). Each group will build the software independently. One student from each group will act as a Product Owner (PO), to which we will release the requirements. PO will then describe the requirements to his/her fellow developers.

• The total duration for the project is 12 weeks. First 4 weeks will be given to learn technologies and clear concepts, also to start developing. The project will be developed as a series of features. Project will have three milestones at each milestone we will evaluate and retrospect the progress made. Total 8 features will be built by students, out of which one will be a surprise feature by students.

For this presentation, imagine that you have a contract with a price with the customer
Agile Methods

Projects using agile methods are in two different situations:

1. In-house software development, or customer is flexible on scope and costs

2. Software is developed by a supplier with a contract with the customer:
   • fixed price / estimated price
   • fixed scope / functionality
   • milestones with deliverables and invoice dates

We will look at this situation
Your Project

How did you start?
The Project Management Knowledge Areas
- Project Scope Management

**Project Scope Management** is about ensuring that the project includes all the work required, and only the work included, to complete the project successfully.

- Plan Scope / Statement of Work
- Collect Requirements / Use Cases / Scenarios
- Define Objectives / Scope / Deliverables / Acceptance Criteria
  - Establish Scope Baseline
  - Define out-of-scope and assumptions
- **Create the Work Breakdown Structure (WBS)**

Scope covers:
- Product Scope – e.g. specifications, functions, features
- Project Scope – e.g. testing, data migration, training
The Project Management Knowledge Areas
- Project Schedule Management

Project Schedule Management is about getting the project done on time.

• Define Activities
• Sequence Activities / Dependencies
• Estimate Activity Resources & Duration
• Develop Schedule
• Define Milestones and Gates
• Control Schedule

Planning is iterative; monitor and revise schedules during the project.

Agile methodologies influence this area of course.
Estimation Techniques:
A good Work Breakdown Structure (WBS) is the base for any estimation, down to task level of 1-2 weeks duration.

1. Three-Point Estimating (PERT) uses three estimates to define an approximate range for an activity’s duration:
   - **Most likely (M):** given the resources likely to be assigned, their productivity, known dependencies and normal interruptions.
   - **Optimistic (O):** Based on the best-case scenario for the activity
   - **Pessimistic (P):** Based on the worst-case scenario for the activity

   \[
   \text{Duration} = \frac{O + 4*M + P}{6} \quad \text{(beta distribution)}
   \]

   Example; Estimate of 8 days with 4 days as optimistic and 20 days as pessimistic results in **9.5 days**

   **Note:** it’s pointless to use 4, 8, 12...
The Project Management Knowledge Areas  
- Project Schedule Management

2. **Expert Judgment**: consult experts and compare estimates  
   -> challenge: do they know the skill level of resources available?

3. **Estimation by analogy**: compare with past projects in the same application domain  
   -> challenge: limited applicability

4. **Algorithmic cost modelling**: use historical data, e.g., lines of code or Function Points  
   -> challenge: requires strict procedures to capture data, can be very effective

5. **Pricing to win**: the project costs whatever the customer has to spend on it  
   -> very risky if fix price contract (unlikely) if not scope is flexible (agile)  
   -> trust is required if Time & Material contract

6. **Planning Poker**, used by Agile teams

   - Each method has strengths and weaknesses  
   - Estimation should ideally be based on several methods  
   - If these do not return approximately the same result, more effort is required to get to one estimate
The Project Management Knowledge Areas
- Project Schedule Management

**Best Practice - Estimation:** Build company specific estimator tools:
- Covering time needed for documentation, meetings, review, tests, assist customer tests, travel
- Covering company specific tasks and experiences

```
Select Type Of Project
- New
- Revised
- Extension
- Change

Select Project Options
- Project Name
- Start Date
- End Date
- Location

Select Project Details
- Customer Name
- Project Start Date
- Project End Date
- Project ID/Client/Contract

Waiting Days: 352
What Days % of Calendar Days: 72%
Travel Costs % of Labor: 15%
Contingency %: 5%
Working Hours/Day: 8
Default Task Duration: 1

Cost Breakdown:
- Build Project
- Assumptions Table
- Transfer to MS Project

Estimated Costs:
- SPP/Q: 300K
- Consultant: 50K
- Implementation Engineer: 200K
- Systems Engineer: 140K
- Trainer: 15K

Total Estimated Costs: 564K USD

```

![Graph showing cost breakdown and project timeline]
### The Project Management Knowledge Areas
- Project Schedule Management

Let's look at an example:

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration (days)</th>
<th>Dependencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>App Design</td>
<td>8</td>
</tr>
<tr>
<td>T2</td>
<td>DB Design</td>
<td>15</td>
</tr>
<tr>
<td>T3</td>
<td>App specification</td>
<td>15</td>
</tr>
<tr>
<td>T4</td>
<td>Data Cleaning</td>
<td>10</td>
</tr>
<tr>
<td>T5</td>
<td>Data Migration</td>
<td>10</td>
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<tr>
<td>T6</td>
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<td>5</td>
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<td>7</td>
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<tr>
<td>T12</td>
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<td>10</td>
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</tbody>
</table>

What is the minimum total duration of this project?
Build Network Diagram

Analyze the Critical Path:

The Critical Path is the sequence of activities that represents the longest path through a project – this determines the shortest duration.

**Answer is 55 days.**

Identify also activities that are close to becoming critical path, ensure those are not delayed.
The Project Management Knowledge Areas
- Project Schedule Management

The same example in a Scheduling tool (MS Project) – Gantt Chart view:
The Project Management Knowledge Areas
- Project Schedule Management

Highlight of Critical Path in Gantt Chart view:
The Project Management Knowledge Areas
- Project Schedule Management

Changing Task 6 from 5 days to 9 days creates a new critical path, and delays the finish one day:
The Project Management Knowledge Areas  
- Project Schedule Management

**Question:** you have estimated **five days** to implement and test a certain function. After **three days** you are finished, it is tested and it works! You face three options now:

A. Review and improve the code for two days to see if you can make it of higher quality and more structured. It will also make it easier to re-use and maintain later. Total effort is 5 days.

B. Develop a cool feature that you came up with, spending two days on this. Total effort is 5 days.

C. Report back to the project manager to start working on another task. Total effort is 3 days.

**What would you do?**

**Parkinson's law** is the adage that "work expands so as to fill the time available for its completion".
Project Resource Management is about organizing, managing, developing and leading the project team.

- **Plan and acquire Project Team**
  - Project Organization
  - Define roles and responsibilities
  - Skills and experiences required
- **Manage & Develop Project Team**
  - Adding and on-boarding team members
  - Plan and develop skills
  - Provide Feedback on performance
  - Manage conflicts & Motivate Team
- **Administration:**
  - Manage & negotiate internal resource agreements
  - Manage & negotiate contracts of external resources
  - Manage work permits
The Project Management Knowledge Areas
- Project Resources Management

Team Organization - Teams should be relatively small (< 8 members)
  • minimize communication overhead
  • team quality standard can be developed
  • programs are regarded as team property (“egoless programming”)
  • members can work closely together
  • continuity can be maintained if members leave

• Break big projects down into multiple smaller projects
• Small teams may be organized in an informal, democratic way
Best Practice: Resource Management and Levelling in Scheduling Tool

Any over-allocation is shown in tool:

Task 7 assigned to Jim:
The Project Management Knowledge Areas
- Project Procurement Management

Project Procurement Management is about purchase or acquire products, services and resources needed in the project.

Examples:
• Resources from external suppliers
• Specialist services
• Hardware, computers, storage
• Cloud services, apps

This also includes evaluation of suppliers and contracting these products and services.
The Project Management Knowledge Areas
- Project Cost Management

**Project Cost Management** is about getting the project done within budget.

- Estimate Costs and Determine Project Budget
- Control Cost - the Project Manager needs to determine *actual cost* incurred and also make a *forecast* of total cost.

The Project Manager will ask how much have you spent on an activity and also how much will you need to complete it.

Reserves also affect cost management:
- Risk contingency reserve
- Management reserve
The Project Management Knowledge Areas
- Project Quality Management

**Project Quality Management** is about ensuring that the project will satisfy the needs for which it was undertaken.

- Document review; peer reviews, formal review meetings (plan time for this!)
- Code review (also plan time for this!)
- Usability test lab / Prototyping
- Testing:
  - Unit tests
  - User tests
  - Performance / Stress tests
  - Acceptance tests
- Pilot usage
- Root cause analysis
- Project Retrospectives

Cutting back in testing and reviewing is a recipe for disaster!
The Project Management Knowledge Areas  
- Project Quality Management

**Best Practice: Project Retrospective**

A **project retrospective** review is an in-depth discussion that happens after the completion of a project, event or activity. It is structured to help the people involved reflect on the project in detail.

Lessons Learned and Best Practices are collected and shared afterwards.

Agile Retrospective approach; short retrospective after each sprint.
The Project Management Knowledge Areas
- Project Risk Management

**Project Risk Management** is about identifying, assessing and controlling risk on a project.

The objectives are to increase the likelihood and impact of positive risks (opportunities) and decrease the likelihood and impact of negative risks in the project.

Risk response strategies (negative risks):
- Avoid
- Transfer
- Mitigate
- Accept
- Escalate

Risks are assessed in terms of Probability and Impact.
## The Project Management Knowledge Areas
### - Project Risk Management

<table>
<thead>
<tr>
<th>Risk</th>
<th>Risk Response</th>
<th>Probability</th>
<th>Impact</th>
<th>Score</th>
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</table>

**Values:**

Probability: 1-99%

Impact: 1-5 (5 highest)
## The Project Management Knowledge Areas
### Project Risk Management

Examples of typical Risks:

<table>
<thead>
<tr>
<th>Risk</th>
<th>Risk Response</th>
<th>Probability</th>
<th>Impact</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lack of skilled resources creates a delay</td>
<td><em>Mitigate:</em> Staffing with top talent and experts, build team, assign resources well in time. <em>Transfer:</em> Out-source some well defined work packages</td>
<td>50%</td>
<td>5</td>
<td>2.5</td>
</tr>
</tbody>
</table>
| 2. Users will not accept application’s user interface                 | *Mitigate:* Invest in Usability Test  
*Avoid:* review early and get more time and/or cut functionality     | 30%         | 3      | 0.9   |
| 3. Developing wrong functions leads to unsatisfied customer          | *Mitigate:* Agile development, sign-off on requirements                       | 20%         | 5      | 1.0   |
| 4. Unknown data in customer’s DB                                     | *Mitigate:* analyze data upfront  
*Escalate:* ask customer to provide sample dataset to test against and do acceptance against | 40%         | 5      | 2.0   |
The Project Management Knowledge Areas
- Project Risk Management

Best Practice: Risk Assessment Workshop

- Brain-storm risks on Post-It notes
- Sort into risk categories
- Group similar risks together
- Assess Probability and Impact
- Start identify risk responses for the top risks

In addition, this is a great exercise for project members from different areas to understand the whole project and the risks.
But even companies with the most rigorous risk management in place fail, example:
Mars Climate Orbiter 1999 crashed
Root cause: Metric vs US units
The Project Management Knowledge Areas  
- Project Communications Management

**Project Communications Management** is about ensuring that the project team has the necessary information and resources to complete the job.

- Project Kick-Off
- Meetings, stand-up meetings
- Project Progress reporting
- Repositories, keeping documents up to date
- Code sharing
- Sharing knowledge, internal social media, social collaboration
- Newsletters

**Quote:**

*Project teams often detest progress reporting because it manifests their lack of progress.*

Communication is key, make sure you communicate on all levels!
The Project Management Knowledge Areas
- Project Communications Management

**Best Practice:** Track deliverables, also specifications and use cases in excel:

This is an excellent way to spot delays early and to communicate plan and progress to project team and to management.

Software development is tricky for management, hard to see progress; make transparent.
The Project Management Knowledge Areas
- Project Integration Management

**Project Integration Management** is about managing all parts of the project to ensure that the project’s objectives are met. It spans across all other nine knowledge areas and processes.

Mainly it is about leadership, driving decisions and negotiate, enabling the project team to work effectively.

- Develop Project Charter / Customer Contracts
- Develop Project Management Plan
- Manage, Monitor and Control Project Work
- Coordination
- **Change Control**
- Close Project or Phase

At any instant, the Project manager must know what is the most important **now** while at the same time looking into the **future**.
Key Take Aways

• Project Management is about managing all parts of the project to ensure that the project’s objectives are met, on time and within budget.

• Project Management is about leadership, driving decisions and negotiate, enabling the project team to work effectively.

• Project Management is a team effort; it requires the support of all team members, even though the benefits of some project management processes are not obvious to all

• Typically, the Project Management effort is 10-15% of total project effort
References, Links

- Agile Retrospectives: [www.funretrospectives.com](http://www.funretrospectives.com)

- Project Management Institute (PMI) [www.pmi.org](http://www.pmi.org)
- PMI Switzerland [www.pmi-switzerland.ch](http://www.pmi-switzerland.ch)


- Siemens PLM Software: [www.plm.automation.siemens.com](http://www.plm.automation.siemens.com/)
Questions?
Appendix – Additional Information

Literature

Sources


Recommended Reading

> The Mythical Man-Month, F. Brooks, Addison-Wesley, 1975
> Succeeding with Objects: Decision Frameworks for Project Management, A. Goldberg and K. Rubin, Addison-Wesley, 1995
## Appendix – Additional Information

### Chief Programmer Teams (example)

- Consist of a kernel of specialists helped by others as required
  - chief programmer takes full responsibility for design, programming, testing and installation of system
  - backup programmer keeps track of CP’s work and develops test cases
  - librarian manages all information
  - others may include: project administrator, toolsmith, documentation editor, language/system expert, tester, and support programmers …

- Reportedly successful but problems are:
  - Can be difficult to find talented chief programmers
  - Might disrupt normal organizational structures
  - May be de-motivating for those who are not chief programmers

### Egoless Programming (example)

- No code “ownership”
- Frequent code reviews to expose defects
  - Review the code, not the developer
- Promotes more “democratic”, less hierarchical team structure
Directing Teams

Managers serve their team
> Managers ensure that team has the necessary information and resources

1. “The manager’s function is not to make people work, it is to make it possible for people to work” — Tom DeMarco

Responsibility demands authority
> Managers must delegate
– Trust your own people and they will trust you.

Directing Teams ...

Managers manage
> Managers cannot perform tasks on the critical path
  – Especially difficult for technical managers!

Developers control deadlines
> A manager cannot meet a deadline to which the developers have not agreed
Appendix – Additional Information

What you should know!

> How can prototyping help to reduce risk in a project?
> What are milestones, and why are they important?
> What can you learn from an activity network? An activity timeline?
> Why should programming teams have no more than about 8 members?

Can you answer these questions?

> What will happen if the developers, not the customers, set the project priorities?
> What is a good way to measure the size of a project (based on requirements alone)?
> When should you sign a contract with the customer?
> Would you consider bending slip lines as a good sign or a bad sign? Why?
> How would you select and organize the perfect software development team?