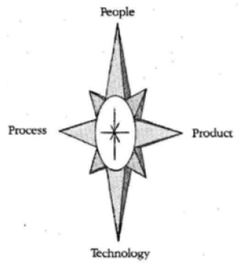
Four Dimensions of Development

People
Process
Product
Technology



Process (1/3)

- Management and Technical Methodologies
- Process represents an area of high leverage in improving development speed
- Hughes aircraft, Lockheed, Motorola, NASA, Raytheon, and Xerox find by focusing on improving their development process
  - Cut time-to-market by about one-half
  - Reduced cost and defects by factors of 3 to 10

Process (2/3)

- Rework avoidance
  - Avoid requirement change at late stages
- Quality Assurance (Q/A)
  - Assure the product has an acceptable level of quality
  - Detect errors at the stage when they are least time-consuming (and least costly) to correct. → catch errors as close as possible to the time that they are introduced
- Development fundamentals
  - Analysis → design → construction → integration → testing will not product lightning-fast schedules, but they prevent disasters
  - Half of the challenge of rapid development is **avoiding disaster**.

Process (3/3)

- Risk management
- Resource Targeting
  - Get the most bang for your buck
- Lifecycle planning
  - Several lifecycle models to be introduced later
- Customer orientation
  - Develop software to its spec. is half job done
  - The other half is help the customer figure out what the product should be (Thus, requirement specification is very important).

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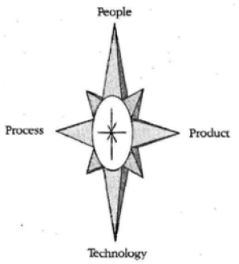


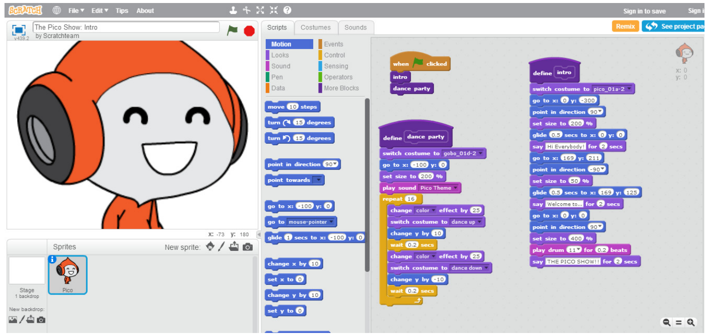
Product

- The most tangible dimension
  - product size
    - 80/20 rule
    - Additional features require additional specification, design, construction, testing, and integration
    - 1/2 produce size → 2/3 effort saving
  - product characteristics
    - Performance, memory footprint, robustness, reliability
    - Don't insist on too many priorities at once!

Technology

- Platform, operation system, software components, development tools, …
- From assembly → high-level languages was one of the most influential changes in software-development history
- Integrated Development Environment, IDE
  - includes Source code editor, compiler, debugger, profiler, …
  - Microsoft Visual Studio, Eclipse, Borland C++ builder, …
  - helps manage the complexity of software projects when there are many classes and methods.
- Visual Programming
  - programming can be done by drag-and-drop without writing a single line of code
  - e.g. Scratch: http://scratch.mit.edu

Scratch



```
move 10 steps
turn ↻ 15 degrees
turn ↺ 15 degrees
point in direction 90
point towards
go to x: -100 y: 0
go to mouse-pointer
glide 1 secs to x: -100 y: 0
change x by 10
set x to 0
change y by 10
set y to 0
```

```
when ⚑ clicked
intro
dance party
```

```
define dance party
switch costume to gobo_01d-2
go to x: -100 y: 0
set size to 200 %
play sound Pico Theme
repeat 16
    change color effect by 25
    switch costume to dance up
    change y by 10
    wait 0.2 secs
    change color effect by 25
    switch costume to dance down
    change y by -10
    wait 0.2 secs
```

```
define intro
switch costume to pico_01a-2
go to x: 0 y: -300
point in direction 90
set size to 200 %
glide 0.5 secs to x: 0 y: 0
say Hi Everybody! for 2 secs
go to x: 169 y: 211
point in direction -90
set size to 50 %
glide 0.5 secs to x: 169 y: 125
say Welcome to... for 2 secs
go to x: 0 y: 0
point in direction 90
set size to 400 %
play drum 11 for 0.2 beats
say THE PICO SHOW!! for 2 secs
```

Example: the Pico show

Summary for 4 dimensions

People

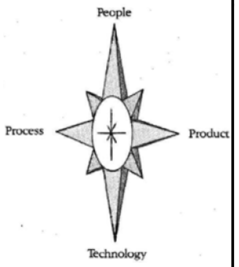
Process

Product

Technology

Which dimension matters the most

- Different projects have different needs
  - Accept the limitations on the dimensions you cannot change
  - Emphasize the other dimensions to get the rest of the schedule benefit you need
- Examples
  - Fuel-injection system for a car
  - In-house business program
  - A feature-driven shrink-wrap market



Lecture 2

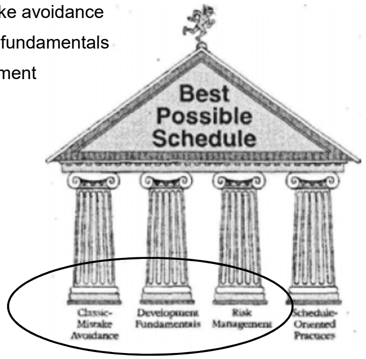
Efficient Development

Review

- Course introduction
- Process of small-scale software development
  - R → A → D → I → TV
- Four dimensions of software development
  - P, P, P, T

Efficient Development

1. Classic-mistake avoidance
2. Development fundamentals
3. Risk management

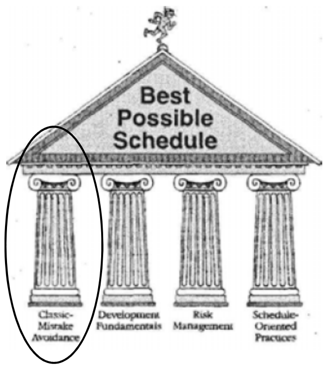


Source: RD

Today’s Topic

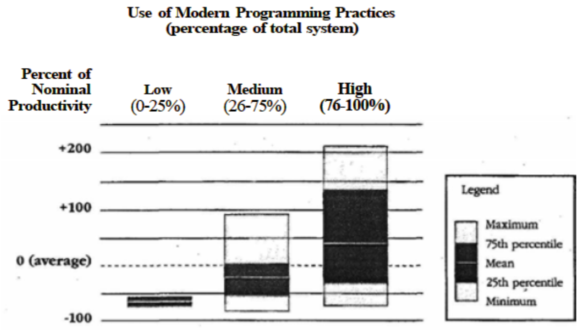
- Efficient Software Development
  - – Class-mistake avoidance
  - – Development fundamentals
    - Management fundamentals
    - Technical Fundamentals
    - Quality-Assurance Fundamentals
  - – Risk management

Classic Mistakes



RD, Chapter 3

Do a few things right isn’t enough



Data based on 44 projects from 9 countries

Need to avoid making any big mistakes !

People

1. Undermined motivation
☆ 2. Weak personnel
3. Uncontrolled problem employees
4. Heroic
5. Adding people to a late project
6. Noisy, crowded offices
☆ 7. Friction between developers and customers
8. Unrealistic expectations
9. Lack of effective project sponsorship
10. Lack of stakeholder buy-in
11. Lack of user input
12. Politics placed over substance
13. Wishful thinking

☆ Most common schedule risks

Process

☆ 14. Overly optimistic schedules
15. Insufficient risk management
☆ 16. Contractor failure
17. Insufficient planning
18. Abandonment of planning under pressure
19. Wasted time during the fuzzy front end
20. Shortchanged upstream activities
21. Inadequate design
☆ 22. Shortchanged quality assurance
23. Insufficient management controls
24. Premature or overly frequent convergence
25. Omitting necessary tasks from estimates
26. Planning to catch up later
27. Code-like-hell programming

☆ Most common schedule risks

Product & Technology

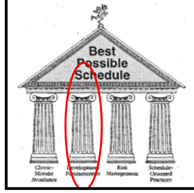
☆ 28. Requirement gold-plating
☆ 29. Feature creep
☆ 30. Developer gold-plating
31. Push-me, pull-me negotiation
☆ 32. Research-oriented development

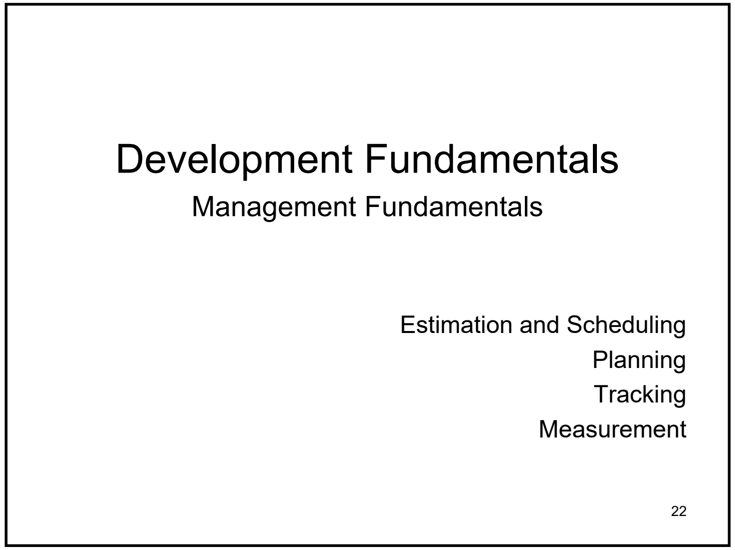
☆ 33. Silver-bullet syndrome
34. Overestimated savings from new tools or methods
35. Switching tools in the middle of a project
36. Lack of automated source-code control

☆ Most common schedule risks

Development Fundamentals

- Applies to “process” dimension
- Includes:
  - Management fundamentals
  - Technical Fundamentals
  - Quality-Assurance Fundamentals

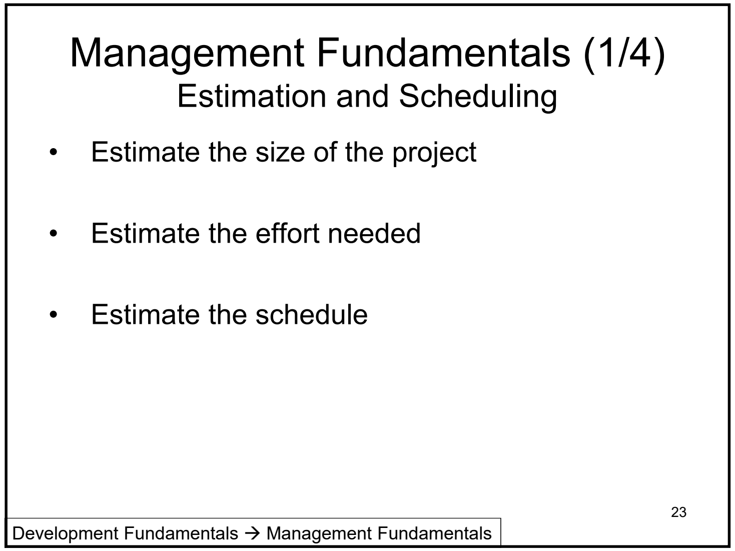




Development Fundamentals

Management Fundamentals

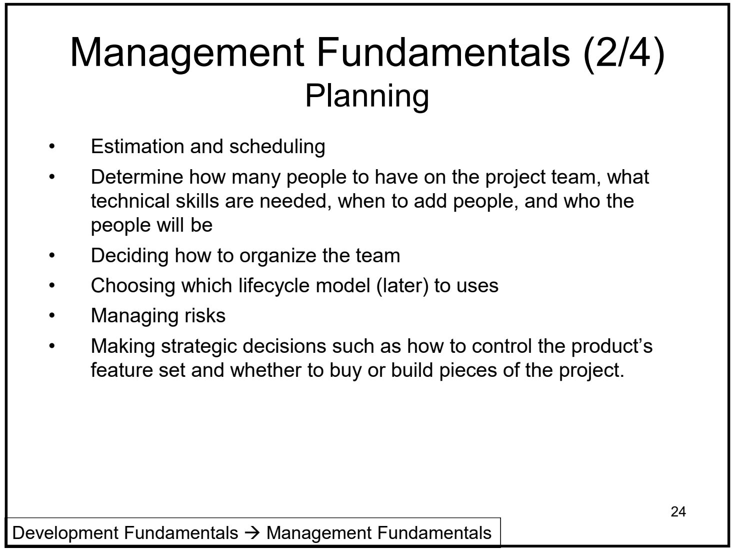
Estimation and Scheduling
Planning
Tracking
Measurement



Management Fundamentals (1/4)

Estimation and Scheduling

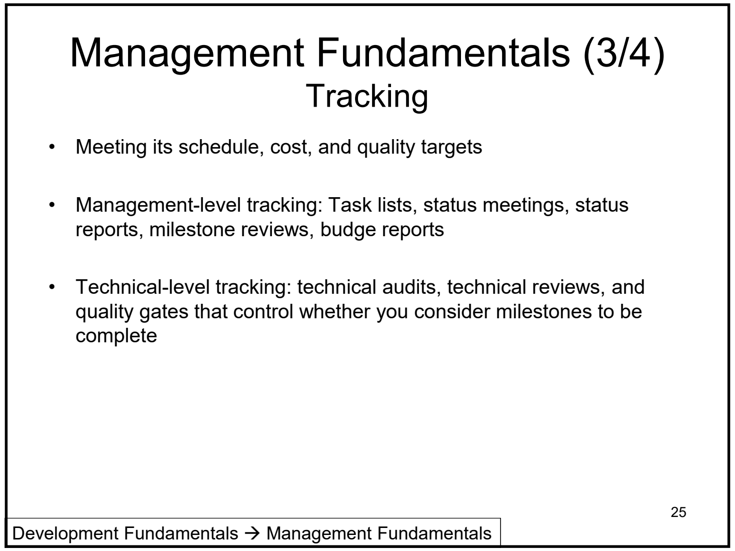
- Estimate the size of the project
- Estimate the effort needed
- Estimate the schedule



Management Fundamentals (2/4)

Planning

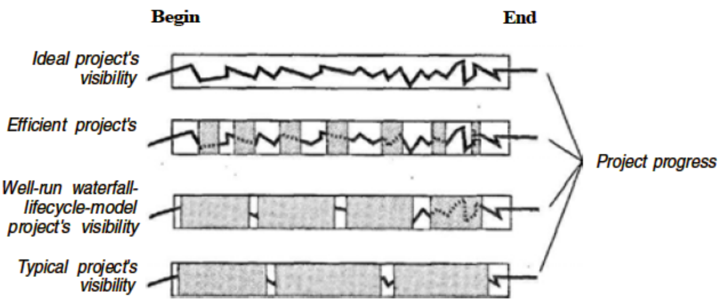
- Estimation and scheduling
- Determine how many people to have on the project team, what technical skills are needed, when to add people, and who the people will be
- Deciding how to organize the team
- Choosing which lifecycle model (later) to uses
- Managing risks
- Making strategic decisions such as how to control the product’s feature set and whether to buy or build pieces of the project.



Management Fundamentals (3/4)

Tracking

- Meeting its schedule, cost, and quality targets
- Management-level tracking: Task lists, status meetings, status reports, milestone reviews, budge reports
- Technical-level tracking: technical audits, technical reviews, and quality gates that control whether you consider milestones to be complete


Begin
End
Ideal project's visibility
Efficient project's
Well-run waterfall-lifecycle-model project's visibility
Typical project's visibility
Project progress

•SEI found 75% of 59 sites assessed between 1987 – 1993 needed to improve their project tracking and oversight (Kitson and Masters 1993)
•Tracking is a fundamental software management activity. If you don't track a project, you can't manage it.

Management Fundamentals (4/4)

Measurement

- Collecting metrics data to analyze software quality (e.g. issue tickets) and productivity (e.g. lines of code, LOC)
- Collect historical project size (e.g. LOC, function points) for future planning reference

Development Fundamentals → Management Fundamentals

Development Fundamentals

Technical Fundamentals

Requirement management
Design management
Software configuration management

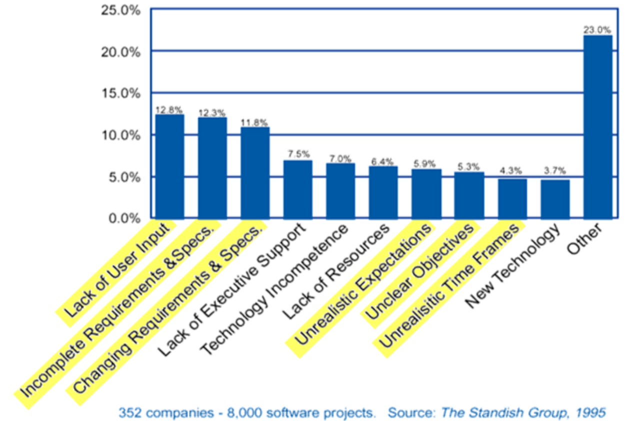
Technical Fundamentals (1/3)

1. Requirement Management

- Gathering requirements: recording them in a document, email, user-interface storyboard, executable prototype, or some other form.
- Tracking the design and code against gathered requirements;
- Managing changes to them.
- The top three reasons that projects were delivered late, over budget, and with less functionality than desired all had to do with requirements-management practices.
- Getting a requirement right in the first place typically costs 50 to 200 times less than waiting until construction or maintenance to get it right.
- Typical projects experience a 25-percent change in requirements.
- Should reduce
  - the number of requirements changes.
  - the cost of each requirements change.

Why Software Projects Fail

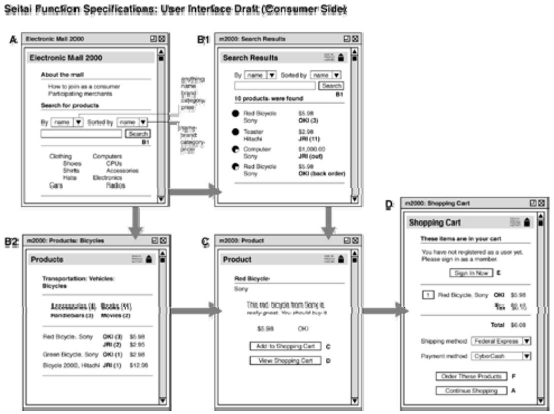
- Average overrun: 89.9% on cost, 121% on schedule, with 61% of content



352 companies - 8,000 software projects. Source: *The Standish Group, 1995*

Boehm (2006), "A View of 20th and 21st Century Software Engineering", ICSE 2006 Keynote Address

UI Storyboard


Seitai Function Specifications: User Interface Draft (Consumer Side)
A
Electronic Mall 2000
Electronic Mall 2000
About the mall
How to join as a consumer
Participating merchants
Search for products
By name
Sorted by name
Search
B1
Clothing
Shoes
Shirts
Hats
Cars
Computers
CPUs
Accessories
Electronics
Radios
anything
name
brand
category
price
name
brand
category
price
B1
m2000: Search Results
Search Results
By name
Sorted by name
Search
B1
10 products were found
Red Bicycle Sony $5.98 OKI (3)
Toaster Hitachi $2.98 JRI (11)
Computer Sony $1,000.00 JRI (out)
Red Bicycle Sony $5.98 OKI (back order)
B2
m2000: Products: Bicycles
Products
Transportation: Vehicles: Bicycles
Accessories (4) Books (11)
Handlebars (3) Movies (2)
Red Bicycle, Sony OKI (3) $5.98
JRI (2) $2.95
Green Bicycle, Sony OKI (1) $2.98
Bicycle 2000, Hitachi JRI (1) $12.98
C
m2000: Product
Product
Red Bicycle
Sony
This red bicycle from Sony is really great. You should buy it
$5.98 OKI
Add to Shopping Cart C
View Shopping Cart D
D
m2000: Shopping Cart
Shopping Cart
These items are in your cart
You have not registered as a user yet. Please sign in as a member.
Sign In Now E
1 Red Bicycle, Sony OKI $5.98
Tax $0.10
Total $6.08
Shipping method Federal Express
Payment method CyberCash
Order These Products F
Continue Shopping A

http://www.kevcom.com/software/veosystems/ui.gif

Technical Fundamentals (2/3)

2. Design Management

- A design error left undetected until system testing typically takes 10 times as long to fix as it would if it were detected at design time.
- Use (UML) diagrams to present design, and review it carefully.
- Design serves as the foundation for construction, project scheduling, project tracking, and project control, and as such effective design is essential to achieving maximum development speed.
- By the time you get to construction, most of the groundwork for your project's success or failure has already been laid.
- Both requirements management and design offer greater leverage on your development schedule than construction does. In those activities, small changes can make a big difference in your schedule.
- Adherence to some of these fundamentals takes time, but it saves time over the life of a project.

Technical Fundamentals (3/3)

3. Software Configuration

- Software configuration management (SCM) is the practice of managing project artifacts so that the project stays in a consistent state over time.
- SCM includes:
  - Evaluating proposed changes
  - Tracking changes
  - Handling multiple versions
  - Keeping copies of project artifacts as they existed at various times.
- Open source solutions for version control:
  - Git: http://git-scm.com
  - SVN (SubVersioN): http://subversion.tigris.org/

Assignment #1

Due: 10/08/2015

Assignment #1
Part I (1/3)

- Form a group/company **throughout the rest of the term** to work on a software project.
  - The project is about starting an e-business for trading used stuff (computer parts)
  - This project involves developing two software systems
    - A two-tier software program for selling and finding used computer parts.
    - A three-tier web application for direct trading online.
  - Please consider your team a company, thus you need a name!
  - **International, inter-laboratory collaborations are encouraged.**
- In this assignment, you and your partners need to have at least one brainstorming session regarding your **business model**.
  - Here is a link on how to conduct a brainstorming session
  - http://projects.edtech.sandi.net/staffdev/tpss99/processguides/brainstorming.html

Assignment #1
Part I (2/3)

- After the brainstorming session, you need to come up with a business proposal with fancy/novel/crazy/money-sucking ideas that you can come up to build a attractive system for people to trade used stuff/computer parts (and hopefully you can make a profit out of these transactions).
- As stated previously, we're going to develop two software for doing e-business. Therefore, this assignment (due in two week), needs to include
  - A business proposal for used **computer parts** trading through telephone and on-line
  - A **software requirement** for the 2-tier desktop application
  - A **software requirement** for the 3-tier web application
  - Your software requirement (at this stage) needs to include all the functionalities that you can think of.

Assignment #1
Part I (3/3)

- Prepare a 7-minute presentation to present your business proposal in the class on **10/08/2015**.
  - Consider your "company" is trying to get funding from venture capitalists/investors to invest your company, so this presentation is really important.
  - Some references on preparing oral presentation:
    - Google: how to prepare business proposal presentation
- Deliverable:
  - Presentation
  - Business proposal

5 key elements of business proposal

- **Solutions**: After you have written a lead paragraph on the company's needs and problems, follow up with a solid presentation of how your business can provide solutions. The key here is to promise solutions you can deliver.
- **Benefits**: All winning business proposals, clearly outline for the company the benefits to be gained from doing business with you. If your small business can offer complete confidentiality and meet tight deadlines state it in your benefits section.
- **Credibility**: This is often the overlooked portion of a business proposal but all winning proposals glow with credibility. If you have worked with clients in the same field or have an award-winning business, then third-party endorsements will build credibility.
- **Samples**: A business proposal with samples and evidence of your ability to deliver is vital to gaining the winning bid. A small sample of your work can show your ability to do the job.
- **Targeted**: A winning business proposal is all about communication. Speak in a language spoken by your intended audience. If the proposal evaluators are from an engineering background or financial department use the appropriate jargon.

REF: http://sbinformation.about.com/cs/bizlettersamples/a/proposal.htm

A simple proposal formula

- **Who**: who will do the work, who will manage the work, who does the customer call if there is a problem, who is responsible for what
- **What**: what needs to be done/delivered, what will be required to do it, what can the customer expect, what it will cost
- **Where**: where will the work be done, where will it be delivered
- **How**: how will the work be done, how will it be deployed, how will it be managed, how will you achieve quality assurance and customer satisfaction, how will risks be mitigated, how long will it take, how will the work benefit the customer
- **When**: when will you start, when will key milestones be scheduled, when will the project be complete, when is payment due
- **Why**: why have you chosen the approaches and alternatives you have selected, why the customer should select you

REF: http://www.captureplanning.com/articles/11562.cfm

Brainstorming process (1/2)

1. In a small or large group select a leader and a recorder (they may be the same person).

2. Define the problem or idea to be brainstormed. Make sure everyone is clear on the topic being explored.

3. Set up the rules for the session. They should include
   - letting the leader have control.
   - allowing everyone to contribute.
   - ensuring that no one will insult, demean, or evaluate another participant or his/her response.
   - stating that no answer is wrong.
   - recording each answer unless it is a repeat.
   - setting a time limit and stopping when that time is up.

http://projects.edtech.sandi.net/staffdev/tpss99/processguides/brainstorming.html

Brainstorming process (2/2)

4. Start the brainstorming. Have the leader select members of the group to share their answers. The recorder should write down all responses, if possible so everyone can see them. Make sure not to evaluate or criticize any answers until done brainstorming.

5. Once you have finished brainstorming, go through the results and begin evaluating the responses. Some initial qualities to look for when examining the responses include:
   - looking for any answers that are repeated or similar.
   - grouping like concepts together.
   - eliminating responses that definitely do not fit.
   - Now that you have narrowed your list down some, discuss the remaining responses as a group.