

ECE444: Software Engineering

Requirements 2: Requirements Elicitation

Shurui Zhou



The Edward S. Rogers Sr. Department
of Electrical & Computer Engineering
UNIVERSITY OF TORONTO

Learning Goals (last lecture)

- Explain the importance and challenges of requirements in software engineering.
- Explain how and why requirements articulate the relationship between a desired system and its environment.
- Identify assumptions.
- Distinguish between and give examples of: functional and quality requirements; informal statements and verifiable requirements.
- State quality requirements in measurable ways

Learning Goals

- Basic proficiency in executing effective requirements interviews
- Understand that requirements are just “design data”, the information you will use to support your design
- Understand what/why/how about personas
- Recognize and resolve conflicts with priorities

Requirements Elicitation

Typical Steps

- Identify stakeholders
- Understand the domain
 - Analyze artifacts, interact with stakeholders
- Discover the real needs
 - Interview stakeholders
- Explore alternatives to address needs

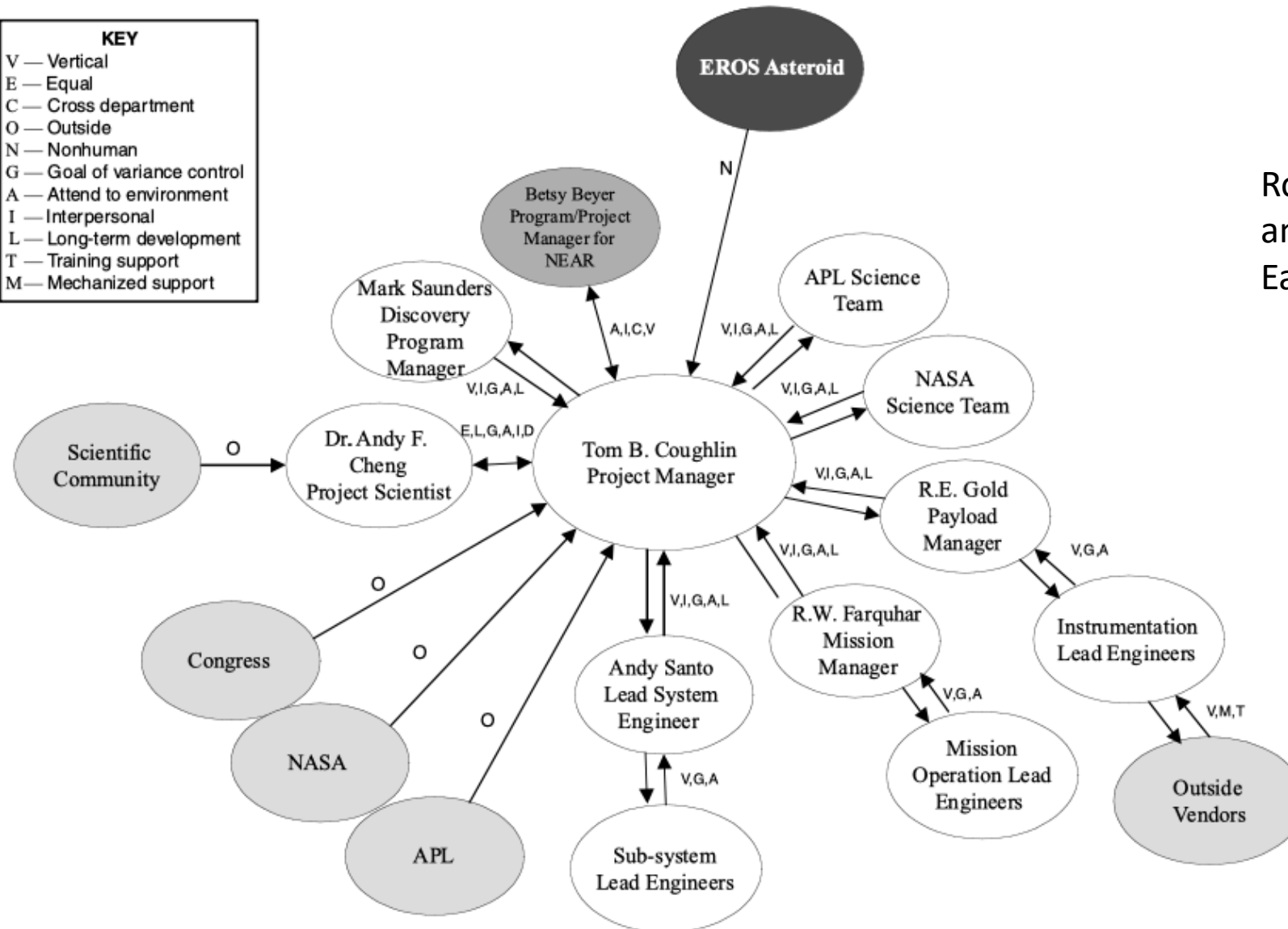
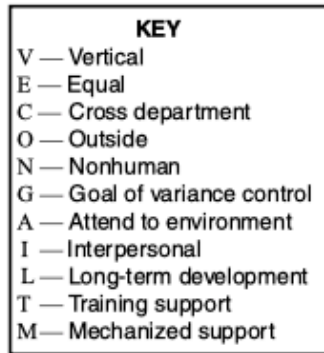
Questions

- Who is the system for?
- Stakeholders:
 - End users
 - System administrators
 - Engineers maintaining the system
 - Business managers
 - ...who else?

Stakeholder

- Any person or group who will be affected by the system, directly or indirectly.
- Stakeholders may disagree.
- Requirements process should trigger negotiation to resolve conflicts.

Stakeholders, a NASA example



Role network for National Aeronautics and Space Administration (NASA's) Near Earth Asteroid Rendezvous project.

<https://web.ssu.ac.ir/Dorsapax/userfiles/Sub55/849.pdf>

Stakeholder analysis: criteria for identifying relevant stakeholders

- Relevant positions in the organization
- Effective role in making decisions about the system
- Level of domain expertise
- Exposure to perceived problems
- Influence in system acceptance
- Personal objectives and conflicts of interest

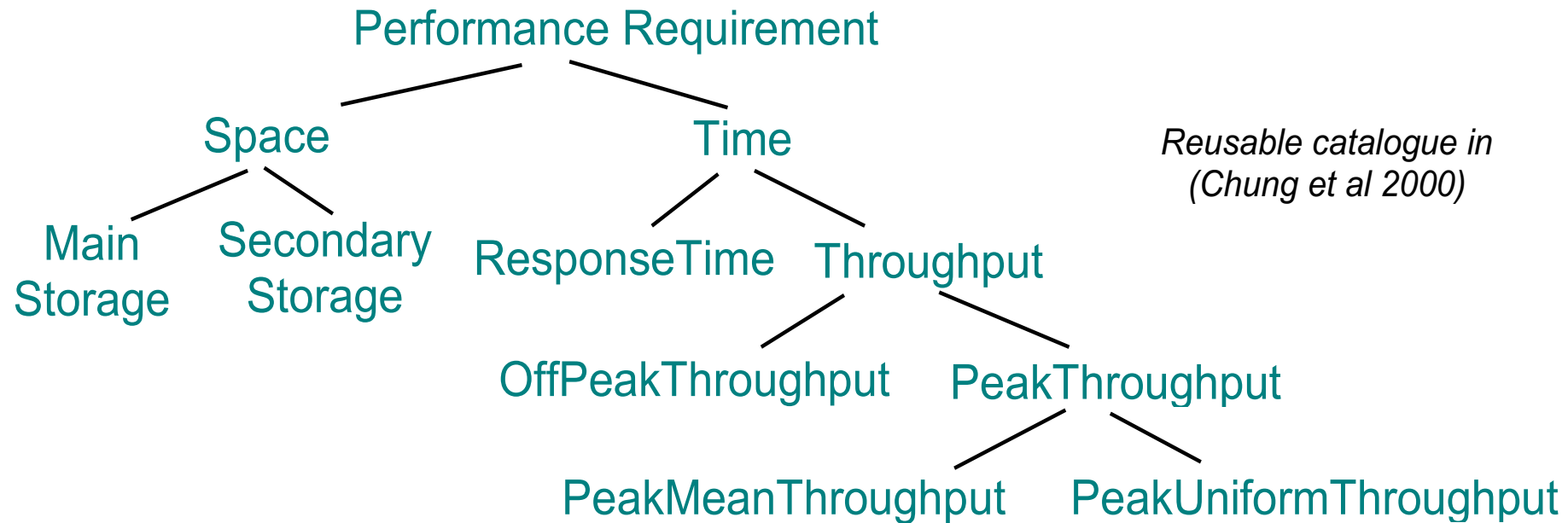
Studying Artifacts (Content Analysis)

- Learn about the domain
 - Books, articles, wikipedia
- Learn about the system to be replaced
 - How does it work? What are the problems? Manuals? Bug reports?
- Learn about the organization
- Knowledge reuse from other systems?

Checklists

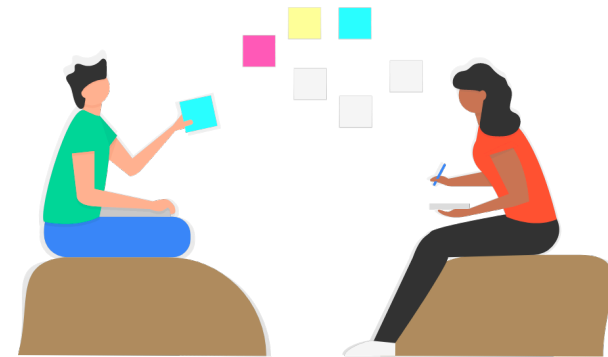
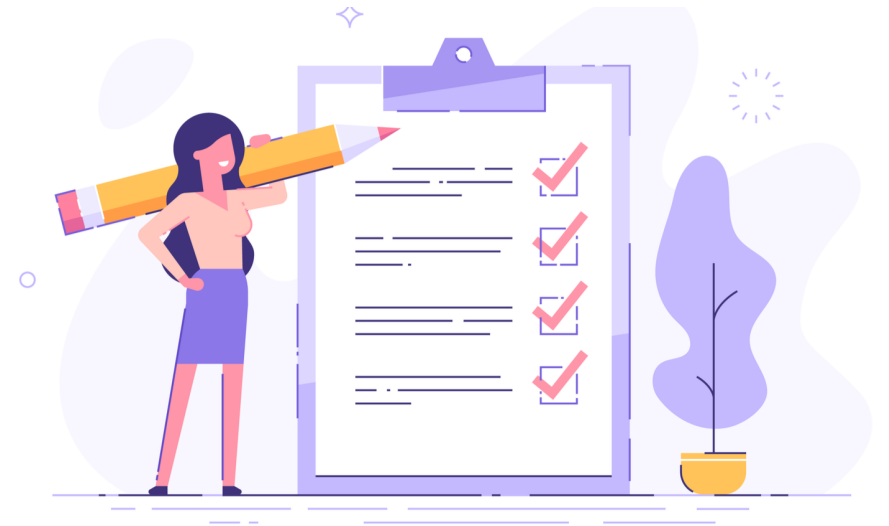
(Domain-independent knowledge)

- Consider list of qualities for relevance, e.g. privacy, security, reliability, ...

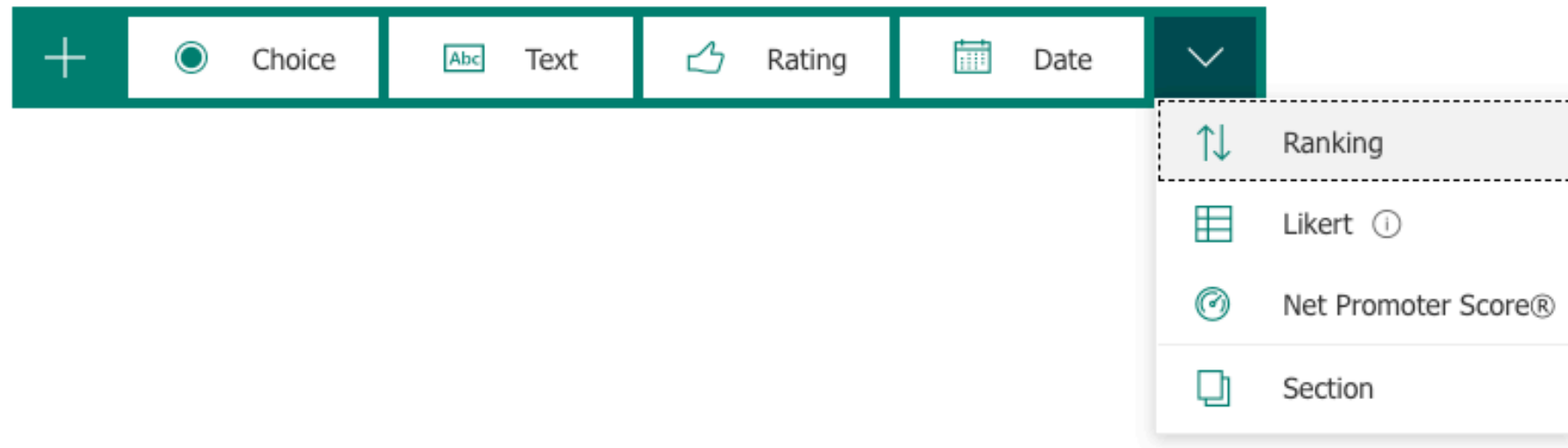


Collecting requirements: Elicit from stakeholders

- **Survey:** measure topics of interest in a controlled, consistent manner; easy to administer across large groups
 - Identify target population, their attitudes and preferences
 - Validate assumptions or facts
- **Interview:** More expensive, but could have follow-up questions to resolve ambiguity



Types of questions: depend on your goals



Closed-ended Questions

- **Nominal scales** provide interviewees with a list of categories from which to select their answer (e.g., White, Black or African American, American Indian, Asian, Native Hawaiian or Pacific Islander)
- Good practices –
 - Solicit response options in a pilot study
 - Randomize order, if concerned about order effects
 - Avoid bias from unequal response options
 - Check all that apply vs. forced-choice

Example: Unequal response options

How likely are you to share your location to meet friends after work?

- Absolutely never
- Sometimes
- Occasionally
- Once or more a week
- Everyday



Is it easy or difficult to distinguish
between these three categories?

If difficult, why?

Open-ended Questions

- **Definition and designation questions**

What-is asks to develop definitions of things

Who identifies the responsible agent

What-kinds-of ask for possible types and exemplars

- **Process, event and exception questions**

How-to ask how an action is performed

When asks about timing constraints, pre-and post-conditions

What-if asks about failures or unexpected events

Follow-on questions result from answers from previous questions

Follow-up questions

Do you mean in general?

Can you recall a specific example?

Did you participate in this example?

Do you remember any events before or after?

What time of day was it?

Who was present?

What happened next?

Interview Tradeoffs

- Strengths
 - What stakeholders do, feel, prefer
 - How they interact with the system
 - Challenges with current systems
- Weaknesses
 - Subjective, inconsistencies
 - Capturing domain knowledge
 - Familiarity
 - Technical subtlety
 - Hinges on interviewer skill

Interview Process

- Identify stakeholder of interest and target information to be gathered.
- Conduct interview.
 - (structured/unstructured, individual/group)
- Record + transcribe interview
- Report important findings.
- Check validity of report with interviewee.

Example: Identifying Problems

- What problems do you run into in your day-to-day work? Is there a standard way of solving it, or do you have a workaround?
 - Why is this a problem? How do you solve the problem today? How would you ideally like to solve the problem?
- Keep asking follow-up questions (“What else is a problem for you?”, “Are there other things that give you trouble?”) for as long as the interviewee has more problems to describe.
- So, as I understand it, you are experiencing the following problems/needs (describe the interviewee’s problems and needs in your own words – often you will discover that you do not share the same image. It is very very common to not understand each other even if at first you think you do).
- Just to confirm, have I correctly understood the problems you have with the current solution?
- Are there any other problems you’re experiencing? If so, what are they?

Example Questions: The User Environment

- Who will be the users of the system?
- What level of education or training do the users have?
- What computer skills do the users have?
- Are users familiar with this type of IT system?
- What technical platforms do they use today?
- Do you know of any plans for future systems or platforms?
- What other IT systems does the organization use today that the new system will need to link to?
- What are your expectations regarding system usability?
- What training needs do you expect for the future system?
- What kind of documentation do you expect?

Survey Organization & Execution

- Begin with salient questions that respondents can easily answer
- Group questions by topic
- Keep in mind ordering effects and biases
 - Acquiescence*: the tendency to agree
 - Social desirability*: the need to present oneself in a desirable light
- During open-ended responses in interviews:
 - Jot down “sign posts” and “way points” in your notes to guide the conversation back to important points
 - Limit tangents and distractions, but be willing to explore unexpected ideas
- Limit interviews and surveys to 30-45 minutes
- Pilot the survey on a friend or colleague!

Kinds of questions

Opening questions: tell us who you are, where you work, and what you enjoy doing most outside of work

Introductory questions: introduce topic, what is the first thing that comes to mind when you hear ____ ?

Transition questions: think back to when... or, when does the process start?

Key questions: what is frustrating or useful about X? did anything change after using Y?

Ending questions: if you had a chance to change Z, what would you say? Did we miss anything?

Sampling Strategies

- **Snowball/Convenience** – sample based on special access and proximity to investigator
- **Extreme/Deviant Case** – highly unusual, notable, exotic, top/bottom of topic
- **Typical/Common Case** – closest to centrality of the topic
- **Stratified Purposeful** – subgroups selected for comparisons
- **Maximum Variation** – illustrate dimensions of the topic to maximize variation

Interview Advice

- Get basic facts about the interviewee before (role, responsibilities, ...)
- Review interview questions before interview
- Begin concretely with specific questions, proposals; work through prototype or scenario
 - Relate to current system, if applicable.
- Be open-minded; explore additional issues that arise naturally, but stay focused on the system.
- Contrast with current system/alternatives. Explore conflicts and priorities
- Plan for follow-up questions

Capturing v. Synthesizing

- Engineers acquire requirements from many sources
 - Elicit from stakeholders
 - Extract from policies or other documentation
 - Synthesize from above + estimation and invention
- Because stakeholders do not always know what they want, engineers must...
 - Be faithful to stakeholder needs and expectations
 - Anticipate additional needs and risks
 - Validate that “additional needs” are necessary or desired

Personas

Personas

“Personas are detailed descriptions of imaginary people constructed out of well-understood, highly specified data about real people”

—John Pruitt & Tamara Adlin



Partitioning the stakeholders into personas

Diversify your selections

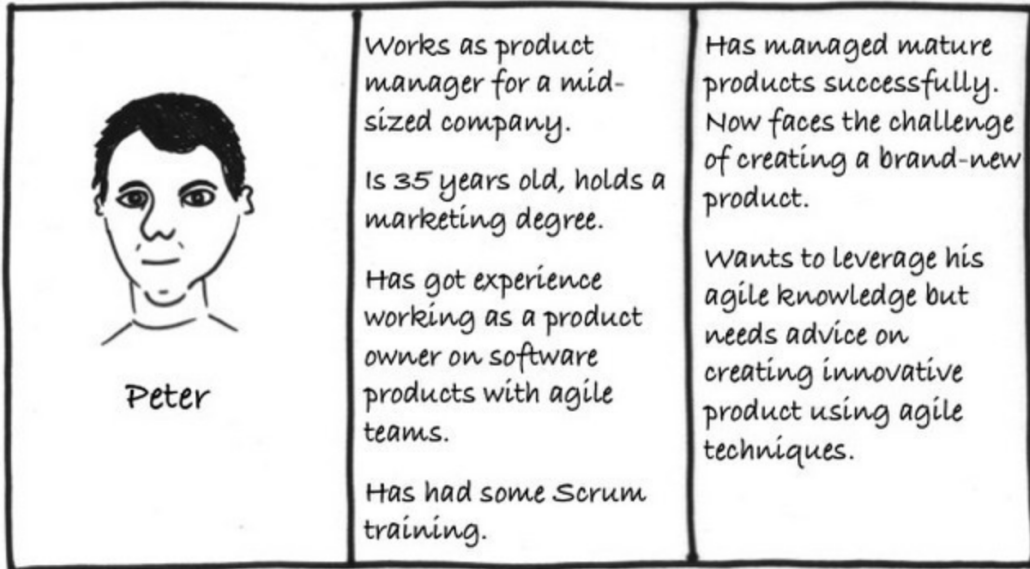
- The common case (most users)
- The extremes (rare, but demanding users)

Why create personas?

Personas...

- Guide developer decisions about features and how people interact with those features
- Help developers keep users and other stakeholders in mind during development
- Supplement (***but cannot replace***) developer access to stakeholders during iterations

Elements of a Persona



1. Persona Group (Banker, Hotelier, Web Manager)
2. Fictional name
3. Job titles and Major Responsibilities
4. Demographics (Age, Education, Ethnicity, and family status)
5. The goals and tasks they are trying to complete using the site
6. Their physical, social, and technological environment
7. A quote that sums up what matters most to the persona as it relates to your site
8. Casual pictures representing that user group

Running example: Time keeper

Project Description

This mobile application allows users to record and monitor how they use their time. The application tracks various types of activity, from work-related meetings to social events and outings. The application helps users achieve targets for increasing productivity and reducing stress through entertainment and social activities.

Project Objectives

- Enable users to track their activities throughout the day and balance work and life goals
- Integrate with existing calendaring and scheduling software
- Help users avoid missing deadlines and manage long-term project goals

Example Persona



Tom

Gender : Male

Age: 25

Status: In a relationship

Job: Graduate student & TA

Behavior & Belief

Tom lives in a rented apartment and commutes to college daily. He works as a T. A. and aims to get a good job, so that he can repay his student loan. He manages his tasks by writing down work in a calendar application. He stopped using time tracking software because he forgot to record his activities. He believes that quality of work is important and often spends huge amount of time doing one task. He mostly uses his laptop for his work and has an internet connection.

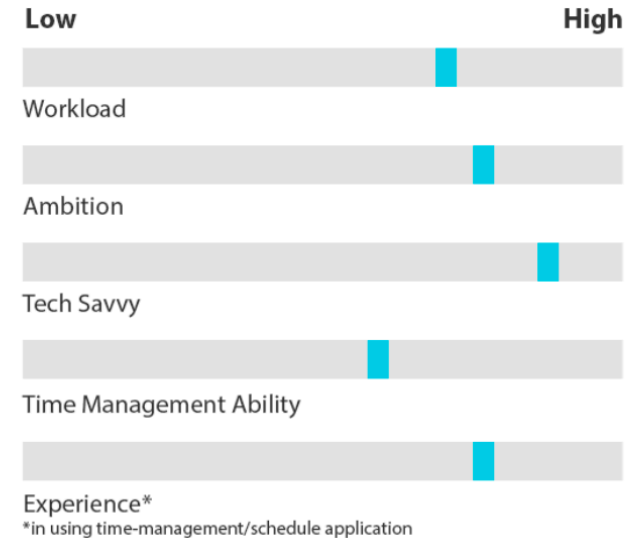
Goals

- To get a good job
- To repay his student loan
- To get good grades by finishing work on time

Values

- Automated tracking to record activities
- Analysis reports to better split time

Characteristics



Fears

- Forget to record his tasks

Pain Point

- Hates to manually enter time

"I would like to track my time but I often forget."

Example Persona



Lee

Gender : Male

Age: 23

Status: Single

Job: Graduate student, first year

Behavior & Belief

Lee had just started his first year in the MSE program. He is taking 51 units and is still getting the feel of how the workload is. But so far, he has been overwhelmed. He has had a lot of sleepless nights. He used the to-do list app on his phone but has not been using it since, Canvas has that feature. He has trouble focusing on a task for more than 30 minutes, so he does it over a period of time. Apart from his study, he practices vocal singing and plays badminton every day. He also likes to cook different dishes. He's on his mobile phone almost all the time to access the social media.

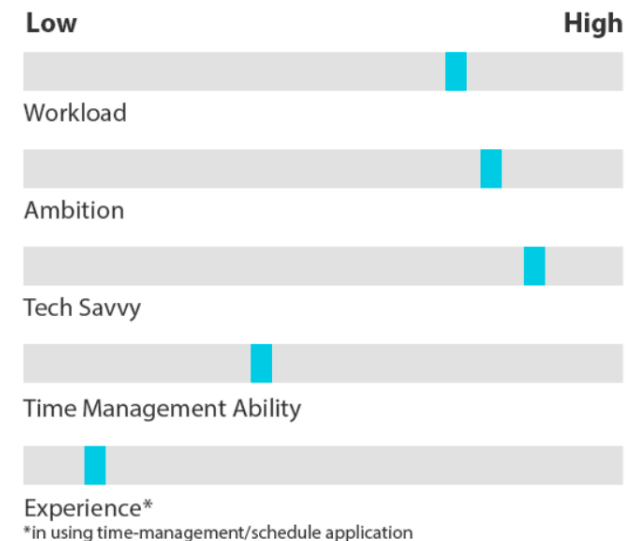
Goals

- Get a high GPA without burning out
- To continue following his hobbies

Values

- Get a reminder when he is behind schedule
- Get motivation to work
- Free to use

Characteristics



Fears

- Missing a deadline

Pain Point

- Managing deadlines

"My heart is in the work. It's hard to balance."

Example Persona



Cher

Gender : Female

Age: 35

Status: Married, one kid

Job: Full time employee
Part-time distance learning student

Behavior & Belief

Cher is 35 years old, married to Luke and is a mother of a 5 year old. She works as a business analyst in Chicago and is a distance learning student at University of Washington. She wakes up early to exercise, drops her kid to school, goes to work and studies while commuting and late in the evening. She uses multiple apps to balance her work and life. Even in her hectic schedule she sometimes manages to go for ice skating and dancing.

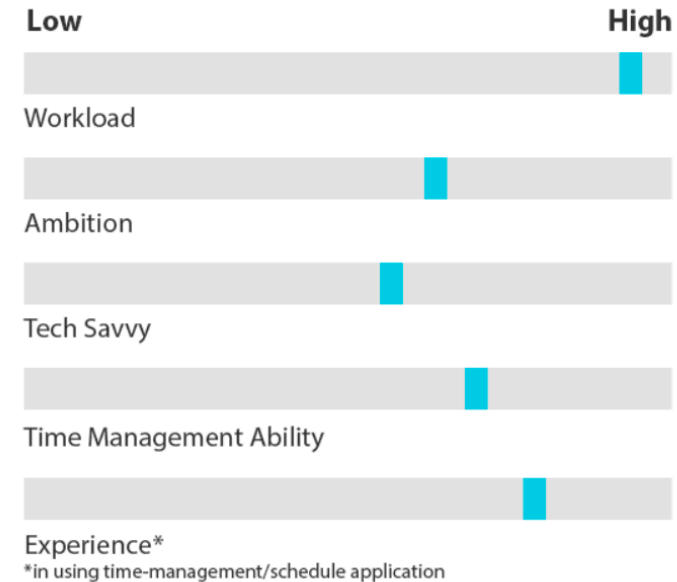
Goals

- To do well academically and advance in professional career
- No compromises on her family's well-being
- Continue to follow her hobbies
- To get good grades by finishing work on

Values

- Provide feedback on what could be done better
- Would prefer using only one app which fulfills her needs
- Distraction free

Characteristics



Fears

- Get delayed in important events such as picking up her kid from school

Pain Point

- Too many apps with redundant features

The GenderMag Method

https://gendermag.org/custom_persona.php



The GenderMag Project



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Abi (Abigail/Abishek)



Abi provides the strongest lens to find inclusiveness issues that disproportionately affect women users. If you choose to use only one persona and your primary motivation is inclusiveness to women, Abi is probably the best first choice. Abi provides the strongest inclusivity lens out of the 3 personas.

Tim (Timothy/Timara)



Tim represents the opposite end of the facet value ranges from Abi, so Tim helps to complete the "sweep" of considering a wide range of facet values. For full coverage of the spectrum, Tim is a good second choice after Abi.

Pat (Patricia/Patrick)



Pat touches (mostly) middle points in the facet ranges between Abi and Tim. If you want a third persona for additional coverage of the facets, Pat is a good third choice after Tim.

Abby Jones¹



You can edit anything in blue print

- 28 years old
- Employed as an Accountant
- Lives in Cardiff, Wales

Abby has always liked music. When she is on her way to work in the morning, she listens to music that spans a wide variety of styles. But when she arrives at work, she turns it off, and begins her day by scanning all her emails first to get an overall picture before answering any of them. (This extra pass takes time but seems worth it.) Some nights she exercises or stretches, and sometimes she likes to play computer puzzle games like Sudoku

Background and skills

Abby works as an accountant. She is comfortable with the technologies she uses regularly, but she just moved to this employer 1 week ago, and their software systems are new to her.

Abby says she's a "numbers person", but she has never taken any computer programming or IT systems classes. She likes Math and knows how to think with numbers. She writes and edits spreadsheet formulas in her work.

In her free time, she also enjoys working with numbers and logic. She especially likes working out puzzles and puzzle games, either on paper or on the computer

Motivations and Attitudes

- **Motivations:** Abby uses technologies to accomplish her tasks. She learns new technologies if and when she needs to, but prefers to use methods she is already familiar and comfortable with, to keep her focus on the tasks she cares about.
- **Computer Self-Efficacy:** Abby has low confidence about doing unfamiliar computing tasks. If problems arise with her technology, she often blames herself for these problems. This affects whether and how she will persevere with a task if technology problems have arisen.
- **Attitude toward Risk:** Abby's life is a little complicated and she rarely has spare time. So she is risk averse about using unfamiliar technologies that might need her to spend extra time on them, even if the new features might be relevant. She instead performs tasks using familiar features, because they're more predictable about what she will get from them and how much time they will take.

How Abby Works with Information and Learns:

- **Information Processing Style:** Abby tends towards a *comprehensive information processing style* when she needs to more information. So, instead of acting upon the first option that seems promising, she gathers information comprehensively to try to form a complete understanding of the problem before trying to solve it. Thus, her style is "burst-y"; first she reads a lot, then she acts on it in a batch of activity.
- **Learning: by Process vs. by Tinkering:** When learning new technology, Abby leans toward process-oriented learning, e.g., tutorials, step-by-step processes, wizards, online how-to videos, etc. She doesn't particularly like learning by tinkering with software (i.e., just trying out new features or commands to see what they do), but when she does tinker, it has positive effects on her understanding of the software.

<http://gendermag.org>

¹Abby represents users with motivations/attitudes and information/learning styles similar to hers. For data on females and males similar to and different from Abby, see <http://eusesconsortium.org/gender/gender.php>



Where should I start?

Get out of the building (GOOB) and talk to your users!

Combining techniques

- Many combined and more specific approaches
- For example Contextual Inquiry:
 - workplace observation +
 - open-ended interviews +
 - prototyping

Creating Personas

Identify important categories of stakeholder

- **Roles** describe the kind of work people do, or their relationship in time to the product
- **Goals** describe what the users hope to achieve
- **Segments** describe shared demographic, attitudes or behaviors of your users

Resolving Conflicts

Conflict Identification

E.G. Human Resources stakeholder group explicitly requests to capture the age of an employee, but the Data Privacy team is saying that the age of the employee may not be captured or used in reporting.

Conflict Analysis

- Data Conflict
- Conflict of interest
- Conflict of Value
- Relationship conflict
- Structural conflict

Types of inconsistency

- Terminology clash: same concept named differently in different statements
 - e.g. library management: “borrower” vs. “patron”
- Designation clash: same name for different concepts in different statements
 - e.g. “user” for “library user” vs. “library software user”
- Structure clash: same concept structured differently in different statements
 - e.g. “latest return date” as time point (e.g. Fri 5pm)
vs. time interval (e.g. Friday)

Types of inconsistency, 2

- Strong conflict: statements not satisfiable together
 - e.g. “participant constraints may not be disclosed to anyone else” vs. “the meeting initiator should know participant constraints”
- Weak conflict (divergence): statements not satisfiable together under some boundary condition
 - “patrons shall return borrowed copies within X weeks” vs “patrons shall keep borrowed copies as long as needed” contradict only if “needed > x weeks”

Handling inconsistencies

- Terminology, designation, structure: Build glossary, domain model
- Weak, strong conflicts: Negotiation required
 - Cause: different objectives of stakeholders => resolve outside of requirements
 - Cause: quality tradeoffs => explore preferences

Conflict Resolution

- Agreement
- Compromise
- Voting
- Definition of Variants
- Overruling
- ...

Documentation of Conflict Resolution

- Document the complete detail of a conflict resolution to prevent the same conflict from arising again during the life of the project.

Requirements Traceability

- Keep connections between requirements
- What follows from what

Summary

- Many solicitation strategies, including document analysis, interviews
- Do not underestimate the challenge of interviews
- Resolving conflicts

about workload

- Milestone 2 (interview) Due Sunday 11:59pm
- Lab 2 (Flask) Due Friday 11:59pm

Milestone 2: Interview

- [does] not provide any guidance about studying artifacts to understand the domain → [of the web application: Chef Co-Pilot]
- Creating interview questions [2-3 per person]
- Conducting 3-4 interviews (15-30min) 1 per person
- Making transcripts (60s) → Tool provided
- Deliverable:
 - a team report
 - individual reflection report