Serious Games for Teaching Software Project Management

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Structure of Presentation

- Problems associated with teaching Software Engineering
- Overcoming these problems with a Serious Games approach
- Disadvantages of Serious Games
- Existing games to teach Software Project Management
- The Requirements Collection and Analysis Game
- Content Integration

Problems associated with Teaching Software Engineering

- Described as a “wicked problem” – incomplete, contradictory and changing requirements
- Armarego (2002) identifies educational dilemmas:
  - Complexity added with increased understanding of the problem
  - Metacognitive strategies fundamental to the process
  - Rich background of knowledge and intuition needed for effective problem-solving
  - Breadth of experience needed so past experiences and similarities can be used to deal with new situations

Problems associated with Teaching Software Engineering

- Oh and Van der Hoak (2001) identify a number of other issues:
  - Software development is non-linear
  - Software development involves several intermediate steps and continuous choice between multiple, viable alternatives
  - Software development may exhibit dramatic effects with non-obvious causes
  - Software engineering involves multiple stakeholders
  - Software engineering often has multiple conflicting goals

Problems associated with Teaching Software Engineering

- Two additional issues:
  - Communication – verbally, in writing, with both internal and external staff
  - Pedagogical praxis: Shaffer (2004a) – different professions have different epistemologies – implementation should be:
    - a) Personally meaningful for the learner
    - b) Relate to the real world outside the classroom
    - c) Provide opportunity to think in the modes of a particular profession
    - d) Reflective of the means of assessment
    - e) Use the tools and practises of the modern-day professional

Problems associated with Teaching Software Engineering

- Problems of teaching a subject of an abstract nature Schon (1983,1987):
  - Learnable but not didactically or discursively teachable
  - Holistic skill – constituents can not be learned in isolation
  - Dependent on the ability to recognize desirable and undesirable qualities – however the recognition can not be described
  - It’s a creative process in which a designer explores new ways of doing things – No description can take the place of learning by doing

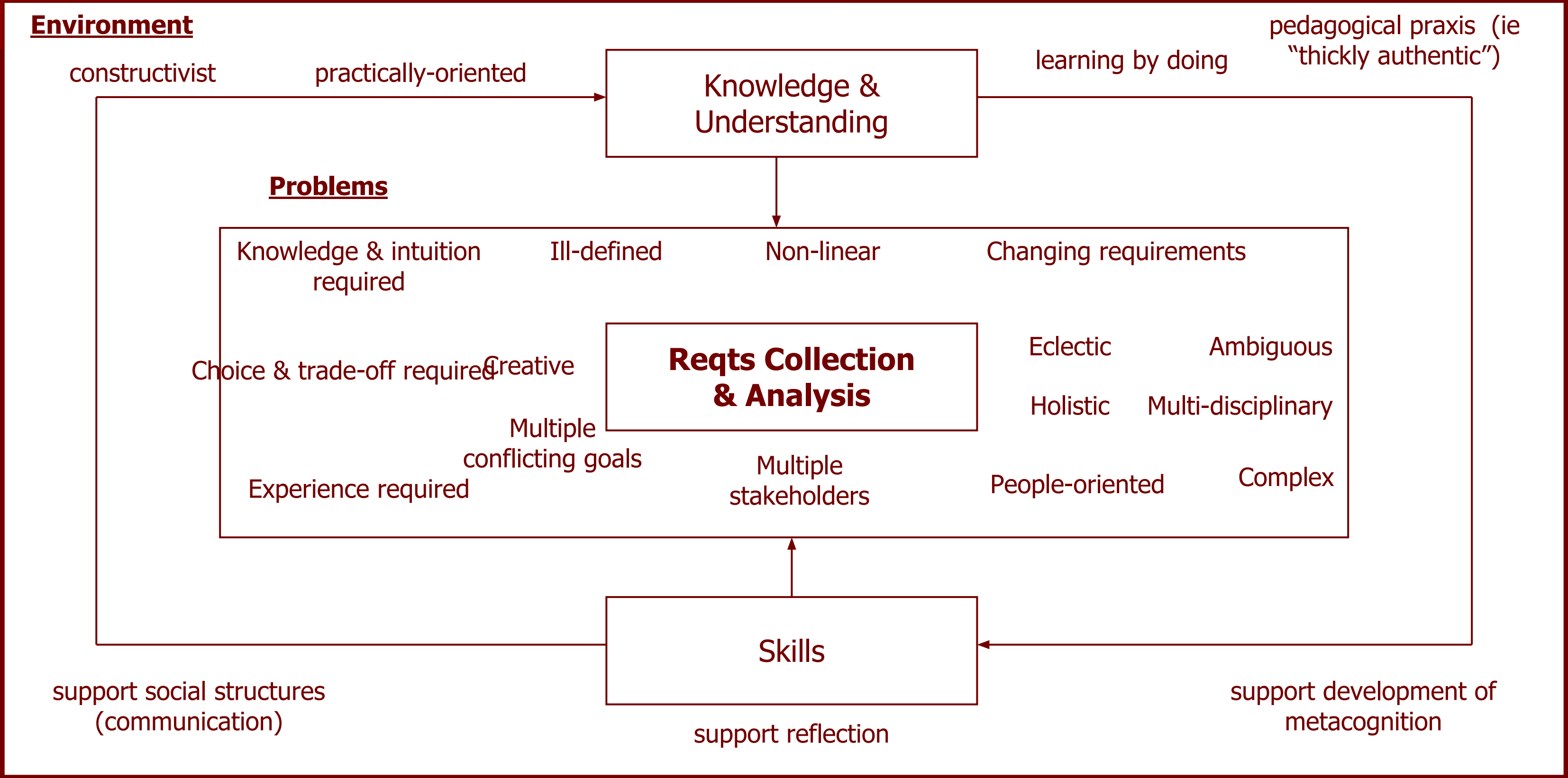
Problems associated with Teaching Software Engineering

- Difficulty comprehending implementation-independent issues and analyzing problems with no single, well known or correct solution (Connolly & Begg, 2006)
- Difficulty handling vagueness and ambiguity and inability to translate tutorial examples to other domains with analogous scenarios (Connolly & Stansfield, in press)
- Lack of confidence to put knowledge into practise and inability to cope with everyday tasks associated with their selected field (Kriz, 2003)
- Field of information systems "has to be experienced to be fully understood and appreciated" (Martin, 2000)
- Can only learn SE by doing SE (Koehler & Mishra 2005)

Alternative teaching paradigm based on constructivism

- Cognitive constructivism – learning is viewed as an active process where learners construct new concepts or ideas upon their past/current knowledge (Piaget, 1968)
- Social constructivism – Individual cognitive gain occurs from interaction with other people and then within the individual (Forman & McPhail, 1993)
- Illeris (2003) believes all learning includes three dimensions:
  - Cognitive dimension of knowledge and skills
  - Emotional dimension of feelings and motivation
  - Social dimension of communication and cooperation

Problems associated with teaching Software Engineering



Environment
constructivist
practically-oriented
Knowledge & Understanding
learning by doing
pedagogical praxis (ie "thickly authentic")
Problems
Knowledge & intuition required
Ill-defined
Non-linear
Changing requirements
Choice & trade-off required
Creative
Reqts Collection & Analysis
Eclectic
Ambiguous
Holistic
Multi-disciplinary
Multiple conflicting goals
Experience required
Multiple stakeholders
People-oriented
Complex
Skills
support social structures (communication)
support reflection
support development of metacognition

A representation of an environment for teaching software engineering (and problems that need to be addressed)

Overcoming these problems with Serious Games

- Supplementary learning intervention
- Realistic – can handle conflict, ambiguity and vagueness
- learning by doing
- Has all the advantages of Role-Playing by use of situated learning.
- Highly scalable and less resource intensive
- Can provide feedback and assessment
- Can incorporate complexity of human interactions
- Practice skills in problem solving and decision-making without the consequences of the real world
- Provides a potentially highly engaging and motivating environment

Disadvantages of Serious Games

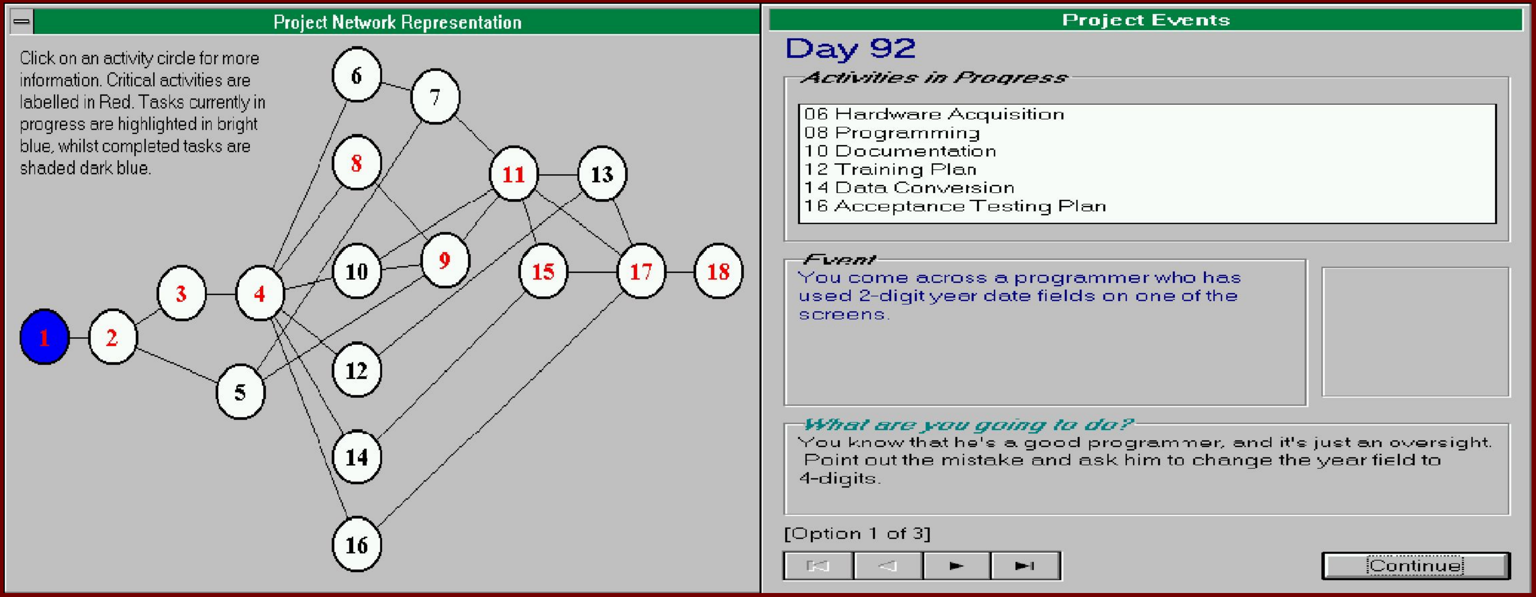
- Development costs
- Negative associations with computer games – gender stereotyping, violence
- May not suit everyone
- Lack of empirical evidence to support the approach

Existing games to teach Software Project Management

- Eight relatively mature games were found:
  - MIS Project Manager
  - SimJavaSP
  - KMQuest
  - Open Software Solutions
  - The Incredible Manager
  - SimSE
  - SimVBSE
  - RPG-SE

MIS Project Manager

- A simulation game produced for the instruction of Information Systems (IS) development from a managerial perspective



Click on an activity circle for more information. Critical activities are labelled in Red. Tasks currently in progress are highlighted in bright blue, whilst completed tasks are shaded dark blue.

Day 92

Activities in Progress

06 Hardware Acquisition
08 Programming
10 Documentation
12 Training Plan
14 Data Conversion
16 Acceptance Testing Plan

Event

You come across a programmer who has used 2-digit year date fields on one of the screens.

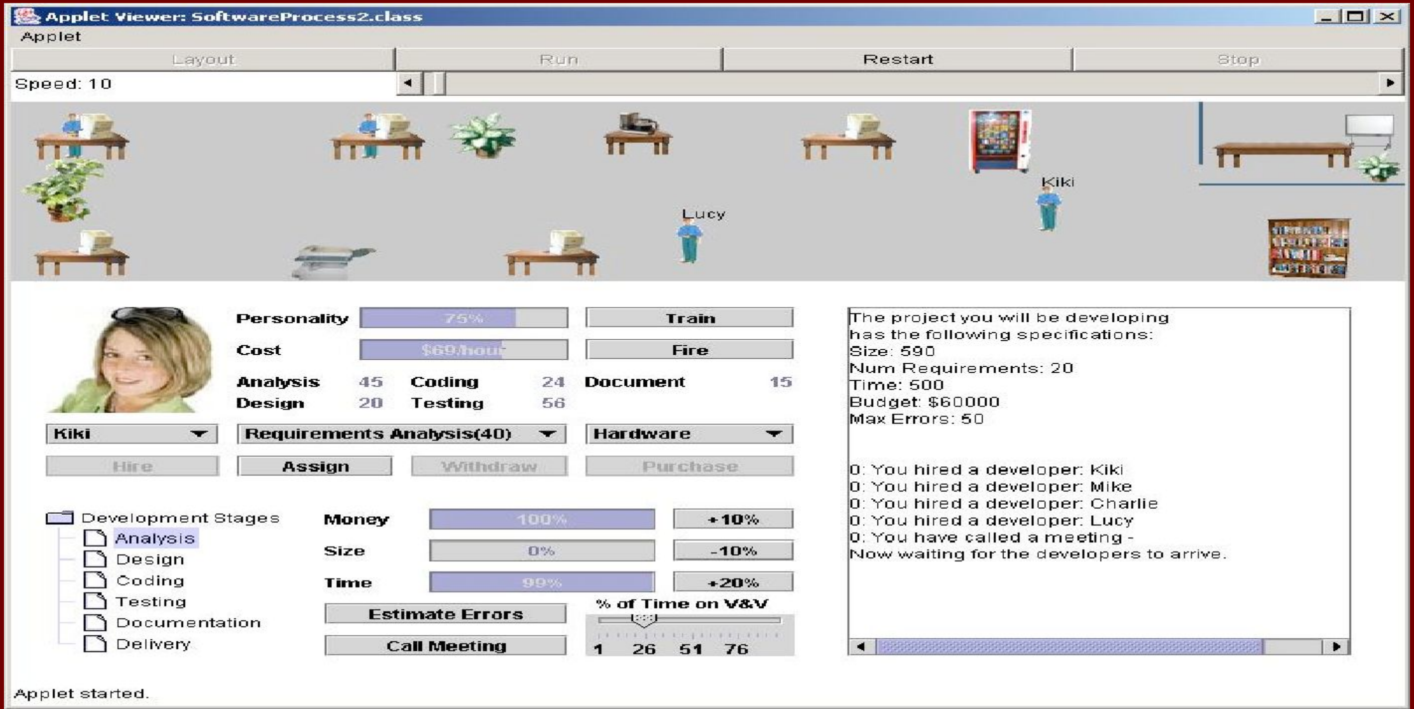
What are you going to do?

You know that he's a good programmer, and it's just an oversight. Point out the mistake and ask him to change the year field to 4-digits.

[Option 1 of 3]

SimJavaSP

- Graphical interactive web-based simulation game designed to increase student’s affinity for software development processes
- Supports the waterfall and spiral model



Speed: 10

Personality 75%

Cost $69/hour

Analysis	45	Coding	24	Document	15
Design	20	Testing	56		

Kiki ▼ Requirements Analysis(40) ▼ Hardware ▼

Money 100%

Size 0%

Time 99%

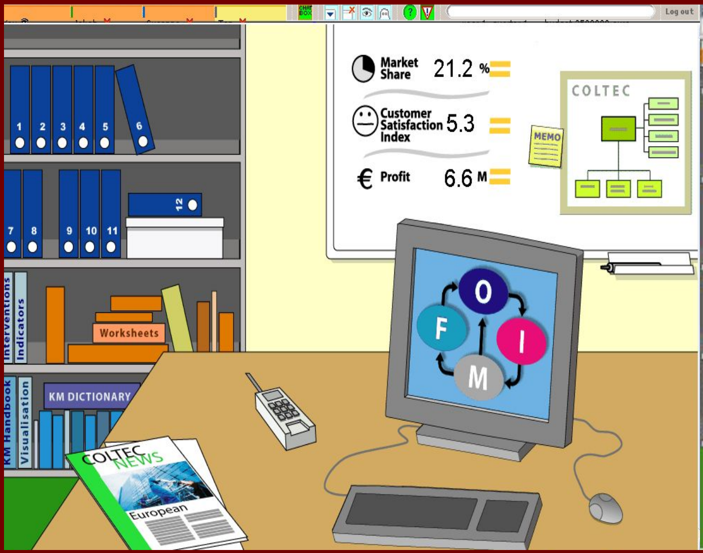
% of Time on V&V 1 26 51 76

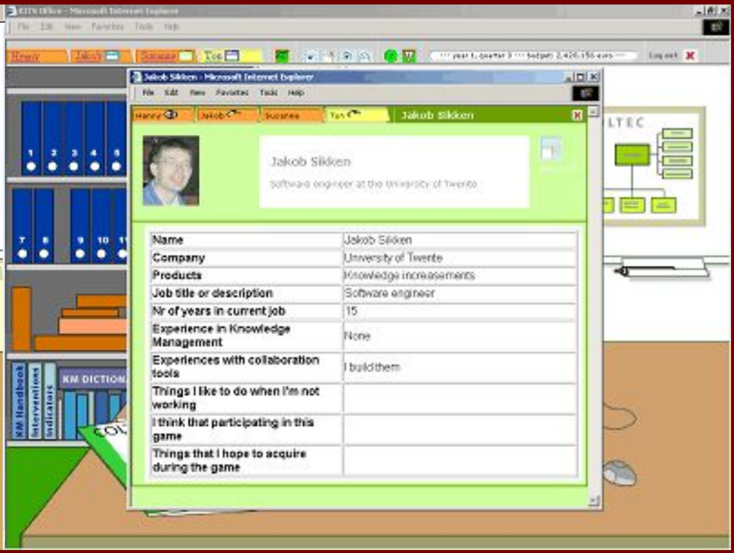
```
The project you will be developing
has the following specifications:
Size: 590
Num Requirements: 20
Time: 500
Budget: $60000
Max Errors: 50


0: You hired a developer: Kiki
0: You hired a developer: Mike
0: You hired a developer: Charlie
0: You hired a developer: Lucy
0: You have called a meeting -
Now waiting for the developers to arrive.
```

Applet started.

KMQuest

- Online collaborative simulation game for teaching knowledge management





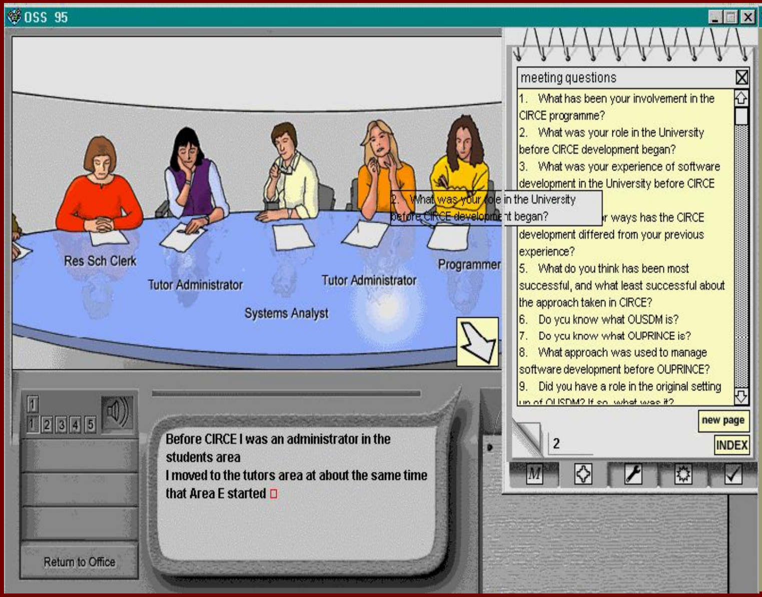
Jakob Sikken

Software engineer at the University of Twente

Name	Jakob Sikken
Company	University of Twente
Products	Knowledge increasements
Job title or description	Software engineer
Nr of years in current job	15
Experience in Knowledge Management	None
Experiences with collaboration tools	I build them
Things I like to do when I'm not working	
I think that participating in this game	
Things that I hope to acquire during the game	

Open Software Solutions

- Developed to be a major part of the Open University’s M880 software engineering distance education course aimed at software professionals



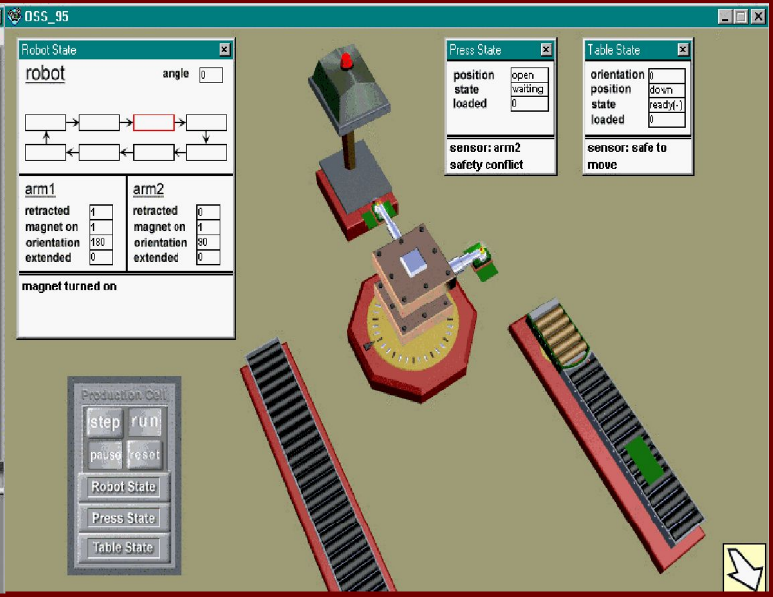
meeting questions

1. What has been your involvement in the CIRCE programme?
2. What was your role in the University before CIRCE development began?
3. What was your experience of software development in the University before CIRCE

2. What was your role in the University before CIRCE development began?

r ways has the CIRCE development differed from your previous experience?
5. What do you think has been most successful, and what least successful about the approach taken in CIRCE?
6. Do ycu know what OUSDM is?
7. Do ycu know what OUPRINCE is?
8. What approach was used to manage software development before OUPRINCE?
9. Did you have a role in the original setting up of OUSDM? If so, what was it?

Before CIRCE I was an administrator in the students area
I moved to the tutors area at about the same time that Area E started



robot angle 0

arm1		arm2	
retracted	1	retracted	0
magnet on	1	magnet on	1
orientation	180	orientation	90
extended	0	extended	0

magnet turned on

Press State

position	open
state	waiting
loaded	0

sensor: arm2 safety conflict

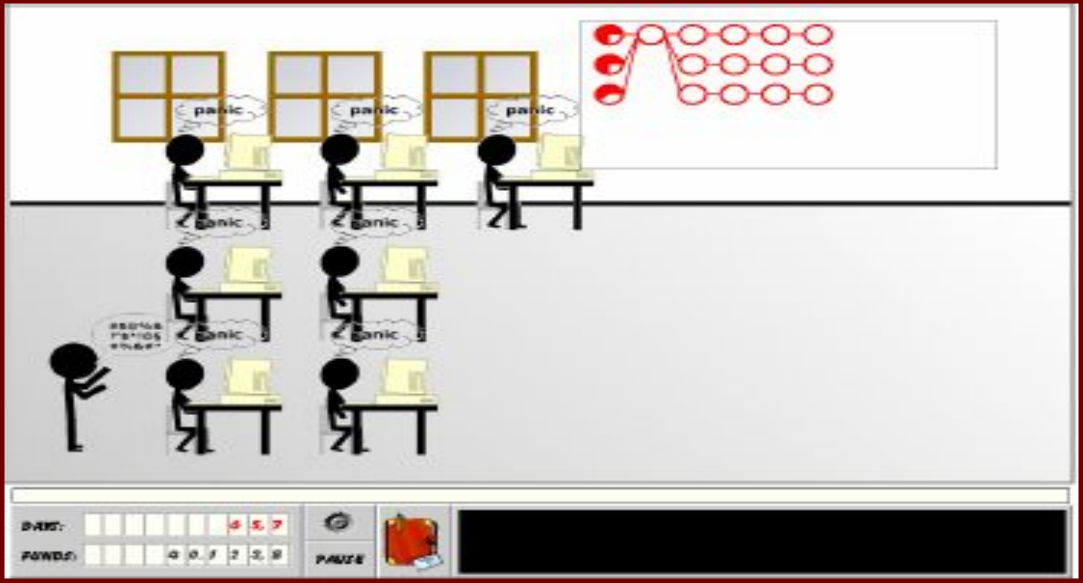
Table State

orientation	0
position	down
state	ready(-)
loaded	0

sensor: safe to move

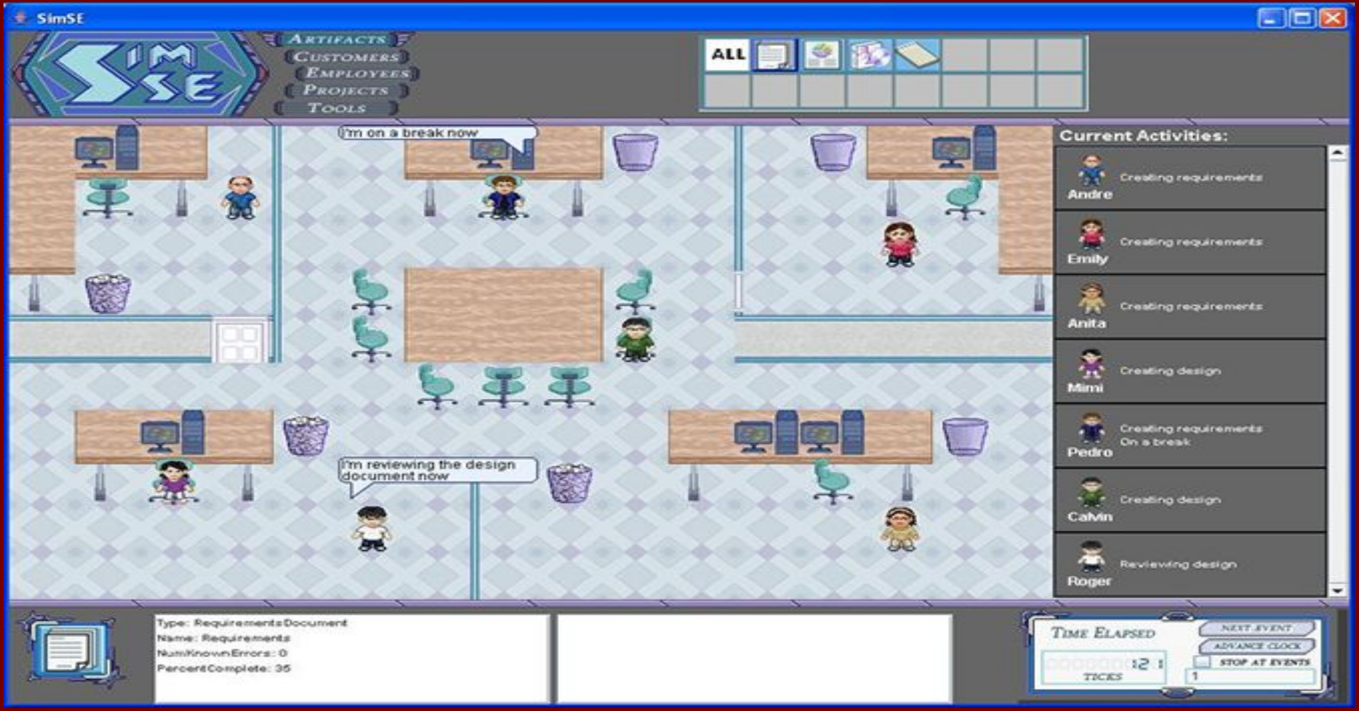
The Incredible Manager

- The Incredible Manager is a simulation game designed to train software project managers. The player must assume the role of a project manager and develop projects within budget, schedule and quality demands



SimSE

- Various different games have been produced by the SimSE model builder a waterfall model game, an incremental delivery model game, a rapid prototyping model game, a rational unified process model game, a code inspection game and an extreme programming (XP) model game.



Current Activities:

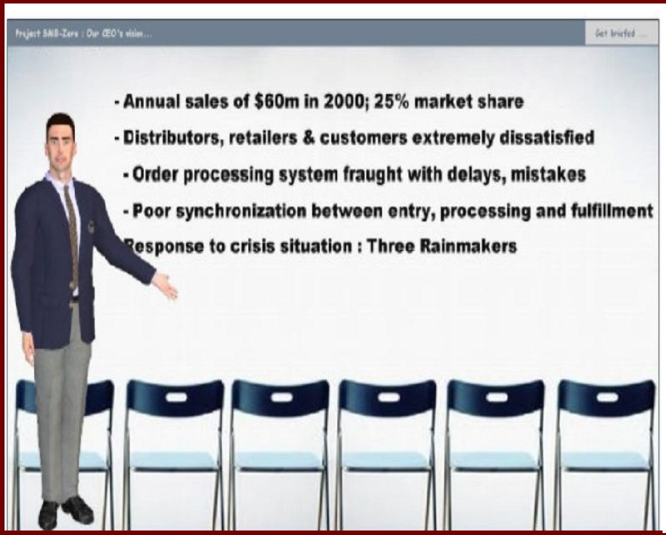
Andre Creating requirements
Emily Creating requirements
Anita Creating requirements
Mimi Creating design
Pedro Creating requirements On a break
Calvin Creating design
Roger Reviewing design

Type: RequirementsDocument
Name: Requirements
NumKnownErrors: 0
PercentComplete: 35

□ STOP AT EVENTS 1

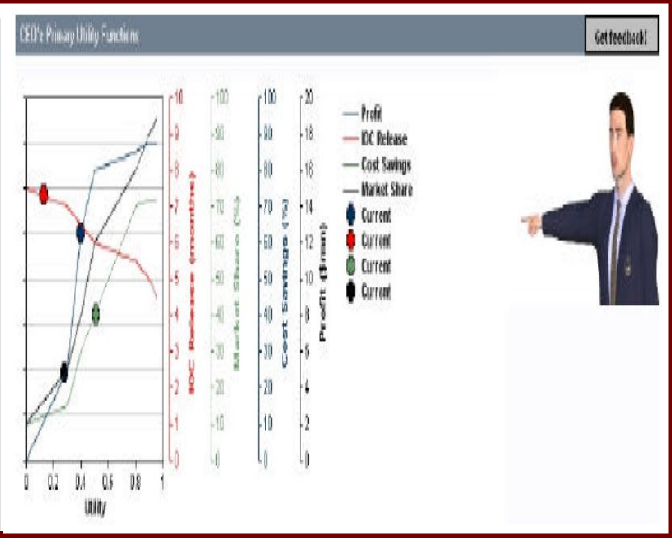
SimVBSE

- Value-based software engineering (VBSE) involving identification of the value preferences of the success-critical stakeholders of the system



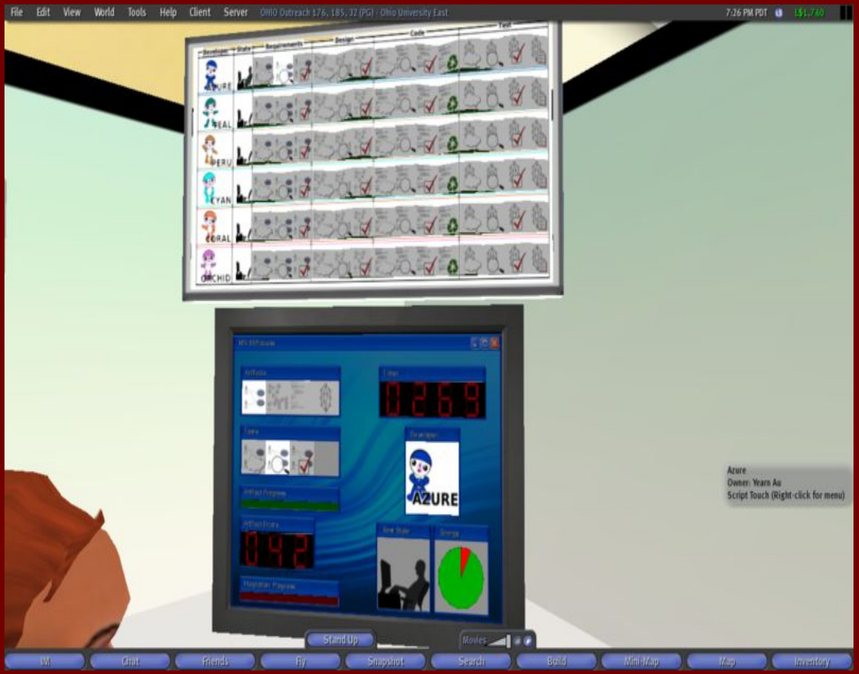
- Annual sales of $60m in 2000; 25% market share
- Distributors, retailers & customers extremely dissatisfied
  - Order processing system fraught with delays, mistakes
  - Poor synchronization between entry, processing and fulfillment

Response to crisis situation : Three Rainmakers



RPG-SE

- Role-Playing Game for Software Engineers (RPG-SE) is a 3D multiplayer online software engineering processing game within Second Life



The Requirements Collection and Analysis Game

- Joint project between Team Play Learning Dynamics based in Dundee and UWS
- TPLD responsible for Eduteams, Infiniteams – www.tpld.net

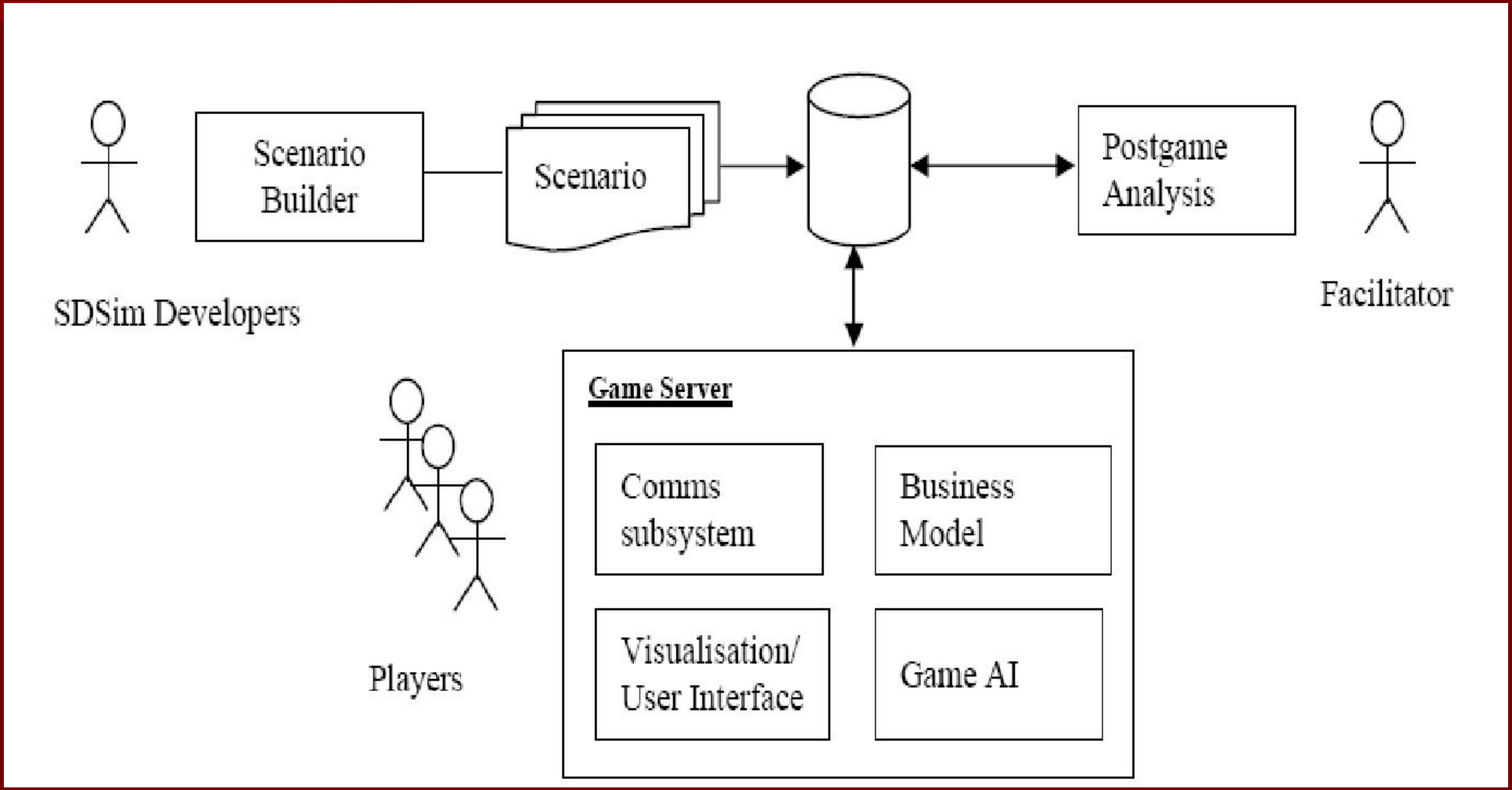
High-Level Objectives

- Promotion of an engineering ethos emphasizing fitness of purpose
- Enable the learner to take a disciplined approach to requirements collection and analysis, high level specification, design and implementation
- Enable the learner to handle ambiguity, vagueness and develop management skills
- Assist in the development of analytical, problem – solving, transferable, autonomous practise and team-working skills
- Assist the learner to develop reflection and metacognitive strategies

Requirements

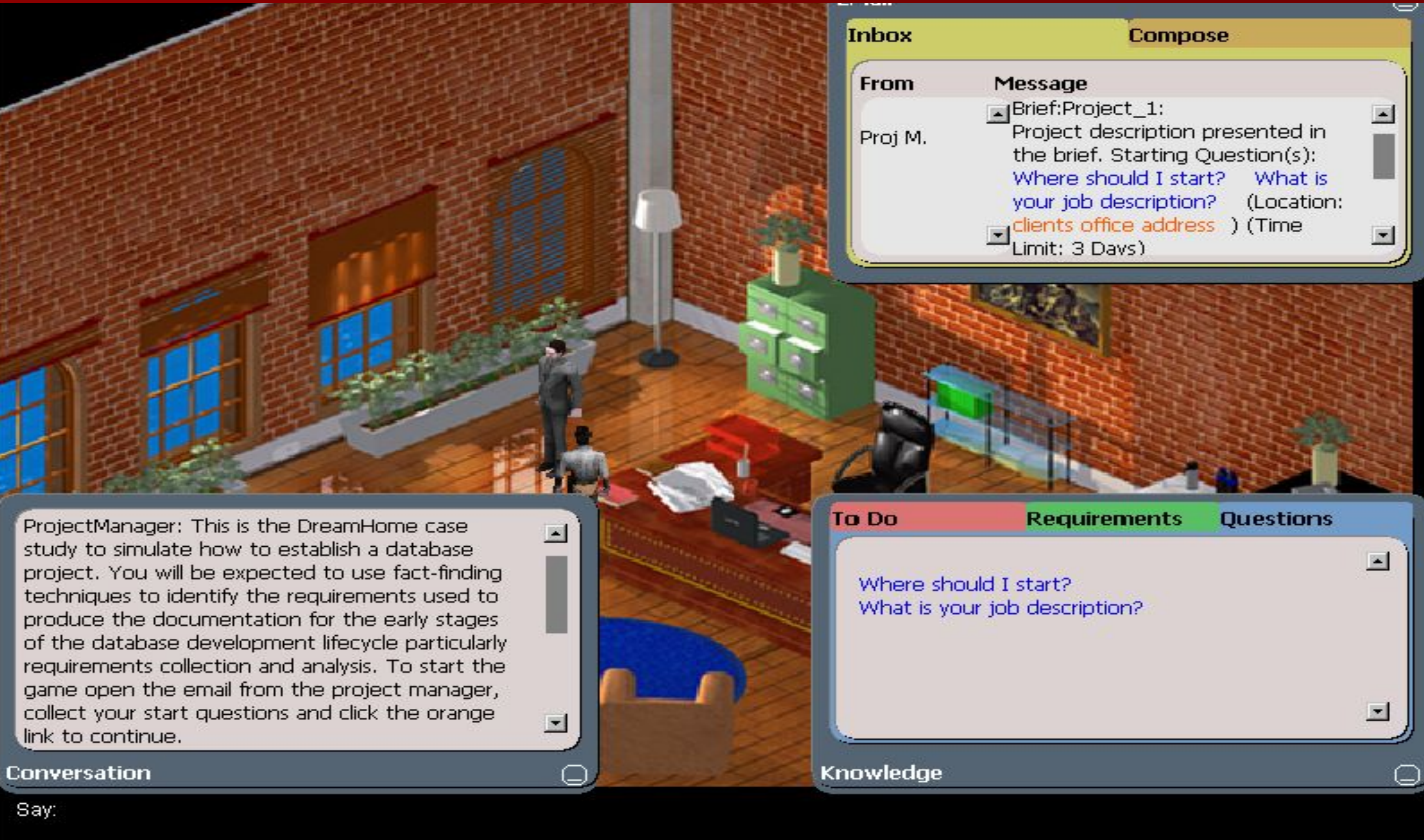
- Targeted at HE students and professional training market
- Must be scenario-based allowing project scenarios to provide practical experience
- Must have a reasonably authentic business model
- Should run in an online environment
- Game play should be recorded wherever possible to support debriefing, post-game analysis and evaluation

Game Design



Scenario Builder
Scenario
Postgame Analysis
SDSim Developers
Facilitator
Game Server
Comms subsystem
Business Model
Visualisation/ User Interface
Game AI
Players

Game Design



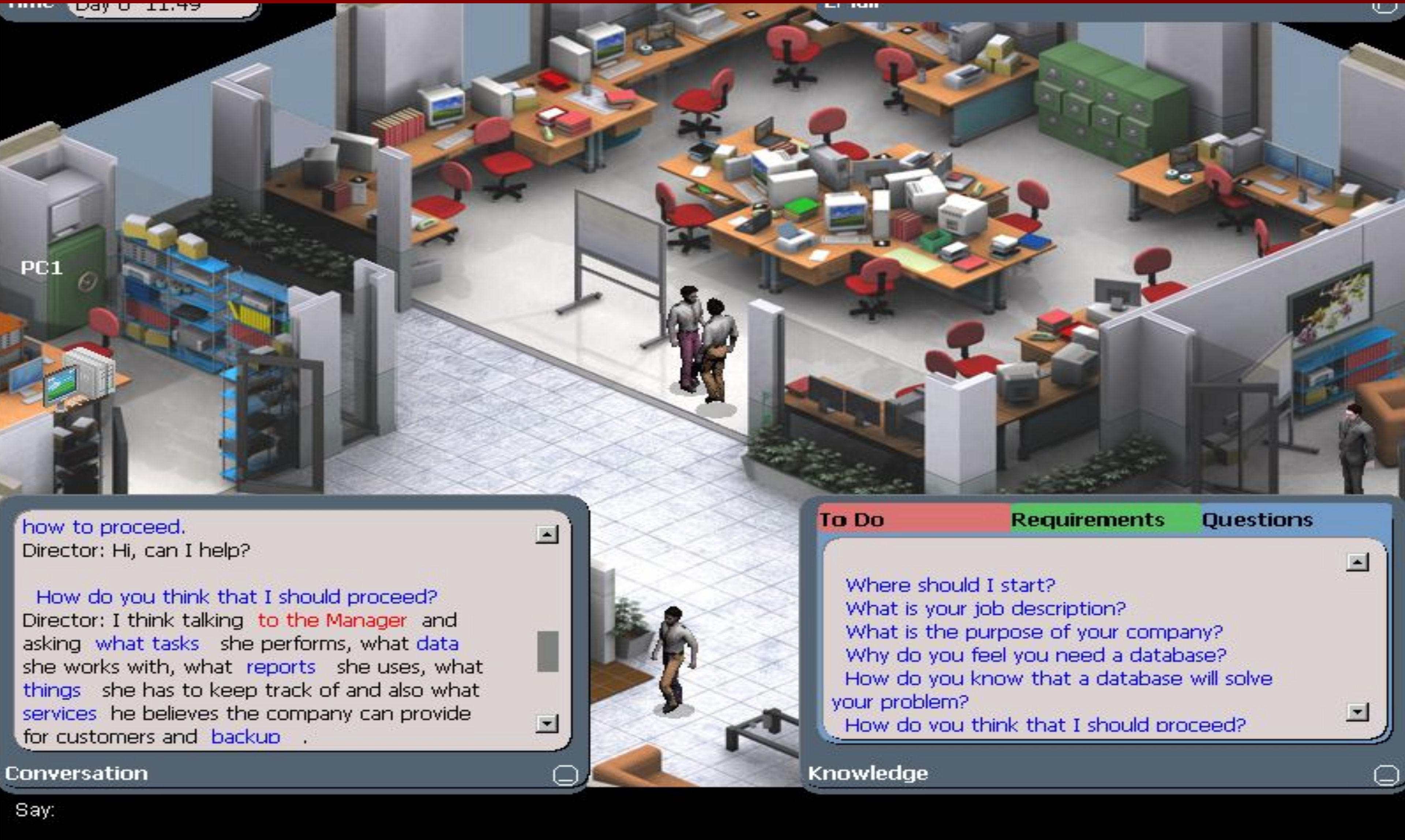
Proj M.

Brief:Project_1: Project description presented in the brief. Starting Question(s): Where should I start? What is your job description? (Location: clients office address) (Time Limit: 3 Days)

Where should I start?
What is your job description?

ProjectManager: This is the DreamHome case study to simulate how to establish a database project. You will be expected to use fact-finding techniques to identify the requirements used to produce the documentation for the early stages of the database development lifecycle particularly requirements collection and analysis. To start the game open the email from the project manager, collect your start questions and click the orange link to continue.

Game Design

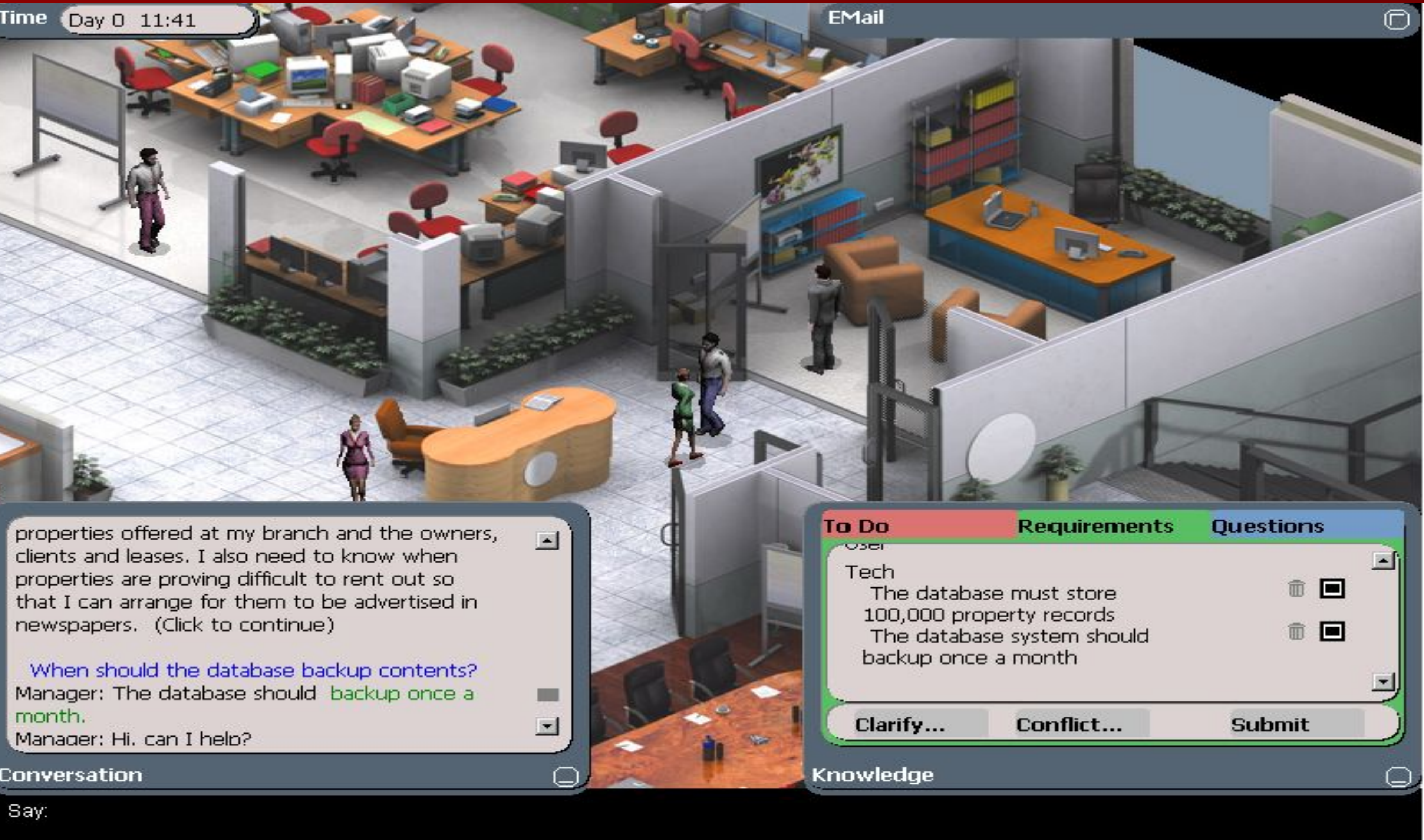


how to proceed.
Director: Hi, can I help?

How do you think that I should proceed?
Director: I think talking to the Manager and asking what tasks she performs, what data she works with, what reports she uses, what things she has to keep track of and also what services he believes the company can provide for customers and backup .

Where should I start?
What is your job description?
What is the purpose of your company?
Why do you feel you need a database?
How do you know that a database will solve your problem?
How do you think that I should proceed?

Game Design



properties offered at my branch and the owners, clients and leases. I also need to know when properties are proving difficult to rent out so that I can arrange for them to be advertised in newspapers. (Click to continue)

When should the database backup contents?

Manager: The database should backup once a month.

Manager: Hi, can I help?

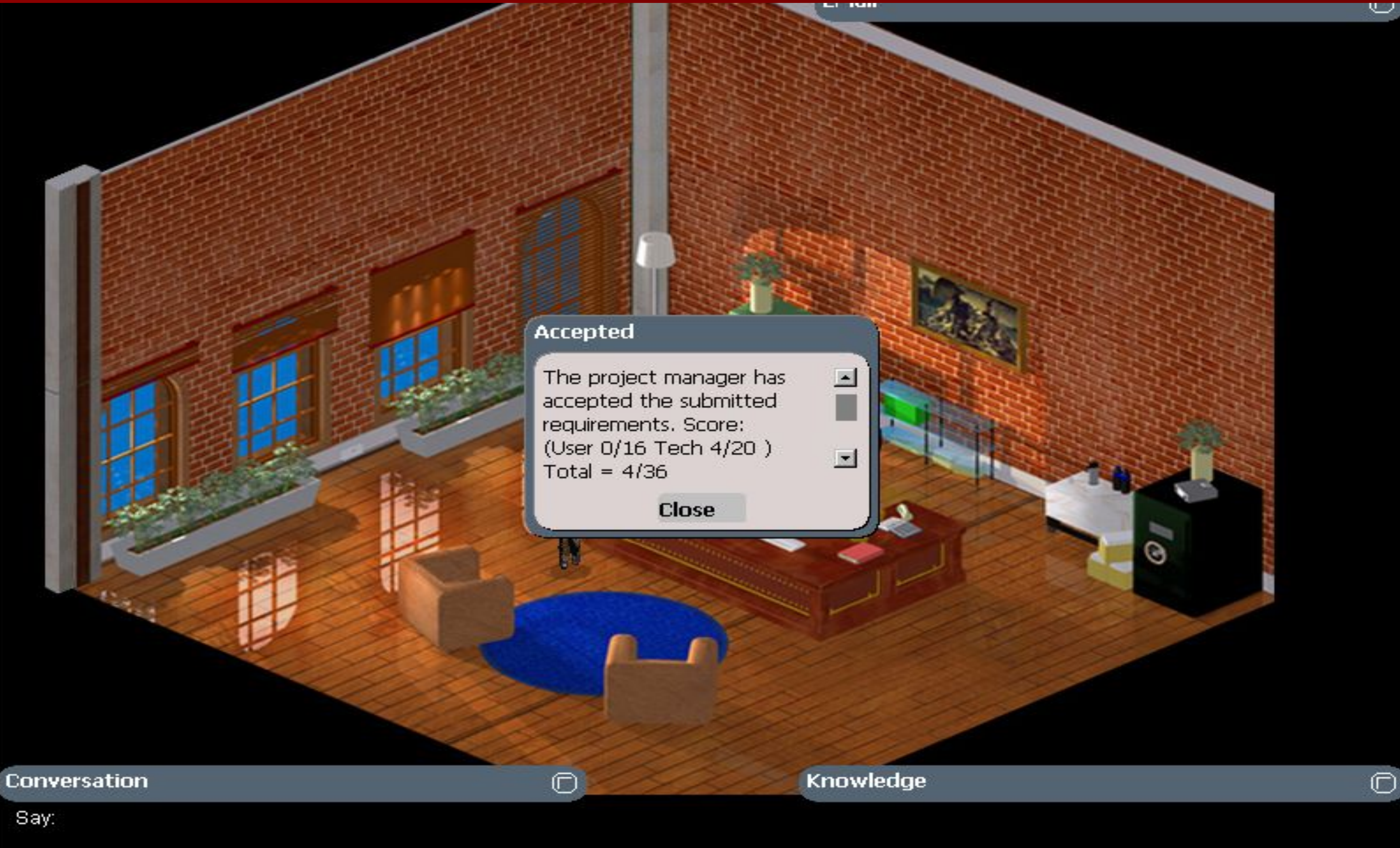
User

Tech

The database must store 100,000 property records

The database system should backup once a month

Game Design

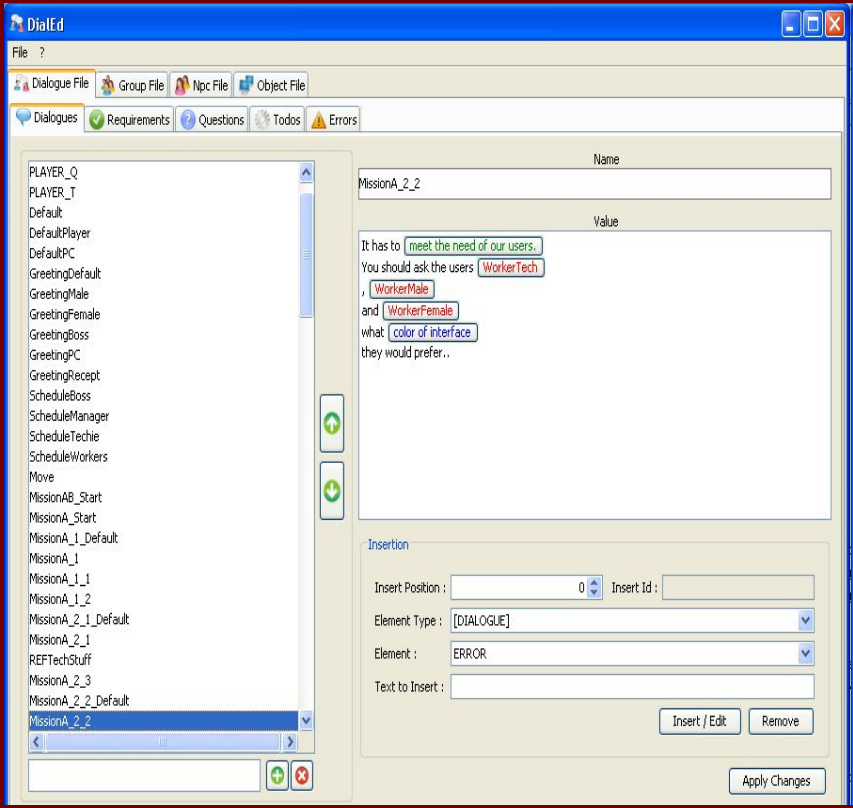


Accepted

The project manager has accepted the submitted requirements. Score: (User 0/16 Tech 4/20) Total = 4/36

Content Integration

- Performed by a Dialog Editor Tool

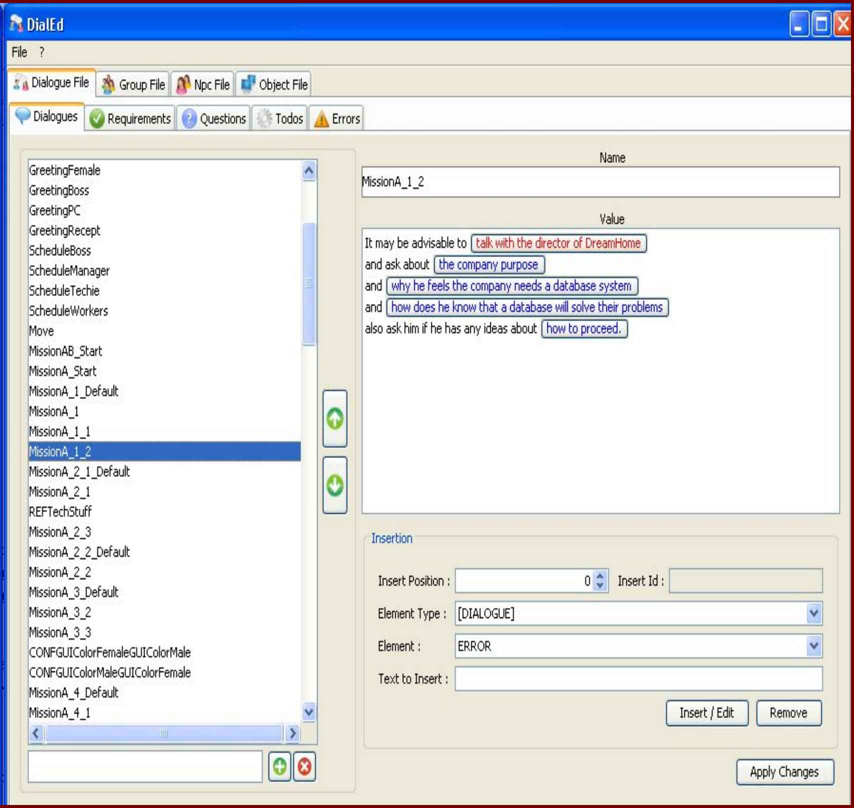


Name: MissionA_2_2

Value:

It has to meet the need of our users.
You should ask the users WorkerTech
, WorkerMale
and WorkerFemale
what color of interface
they would prefer..

Insert Position : 0
Insert Id :
Element Type : [DIALOGUE]
Element : ERROR
Text to Insert :



Name: MissionA_1_2

Value:

It may be advisable to talk with the director of DreamHome
and ask about the company purpose
and why he feels the company needs a database system
and how does he know that a database will solve their problems
also ask him if he has any ideas about how to proceed.

Insert Position : 0
Insert Id :
Element Type : [DIALOGUE]
Element : ERROR
Text to Insert :