

CS342 Software Engineering

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Lecture 7 REQUIREMENTS CASE STUDY

*Adapted from Software Engineering, by Dr. Paul E. Young
& slides by Dr. Mohammad Daoud*

Requirements Case Study

- The MSG Foundation provides low-cost mortgage loans for new low-income couples to purchase houses.
- The MSG trustees place an order for a pilot project
 - A software product to determine how much money is available each week to purchase houses.

Initial Understanding of the Domain

- A house costs \$100,000
- Borrower pays a 10% deposit and borrows the balance
 - The *principal* (or *capital*) borrowed is \$90,000
- Loan is to be repaid monthly over 30 years
 - Interest rate of 7.5% per annum (or 0.625% per month)
- Each month, the borrower pays \$629.30
 - Part of this is the interest on the outstanding balance
 - The rest is used to reduce the principal
- The **monthly payment** is therefore often referred to as P & I (**principal and interest**)

First Month Mortgage Payment

- A *mortgage* is a loan in which real estate is used as security
- In the first month the outstanding balance is \$90,000
 - Monthly interest at 0.625% on \$90,000 is \$562.50
 - The remainder of the P & I payment of \$629.30, namely \$66.80, is used to reduce the principal
- At the end of the first month, after the first payment has been made, only \$89,933.20 is owed to the finance company.

Second Month Mortgage Payment

- In the second month the outstanding balance is \$89,933.20
 - Monthly interest at 0.625% on \$89,933.20 is \$562.08
 - The remainder of the P & I payment of \$629.30, namely \$67.22, is used to reduce the principal
- At the end of the second month, after the second payment has been made, only \$89,865.98 is owed to the finance company

Mortgage Payments After 15 and 30 Years

- After 15 years (180 months) the outstanding balance is \$67,881.61
 - Monthly interest at 0.625% on \$67,881.61 is \$424.26
 - The remainder of the P & I payment of \$629.30, namely \$205.04, is used to reduce the principal
- After 30 years (360 months), the entire loan will have been repaid

Insurance Premiums

- The finance company requires the borrower to **insure the house**
 - If the house burns down, the check from the insurance company will then be used to repay the loan
- The insurance premium is paid once a year by the finance company
 - The finance company requires the borrower to pay monthly insurance installments
 - These are deposited in an *escrow account* (a savings account)
- The annual premium is then paid from the escrow account

Real Estate Taxes

- Real-estate taxes paid on a home are treated the same way as insurance premiums
 - Monthly installments are deposited in the escrow account
 - The annual real-estate tax payment is made from that account

Other Costs

- The finance company requires a **lump sum** up front in return for lending the money to the borrower
 - Typically, the finance company will want 2% of the principal (“2 points”)
 - For the \$90,000 loan, this amounts to \$1,800
- There are other costs involved in buying a house
 - **Legal costs**
 - **Various taxes**
- When the deal is “closed,” the **closing costs** (legal costs, taxes, and so on) plus the points can easily amount to \$7,000

Initial Glossary

Balance: the amount of the loan still owing

Capital: synonym for principal

Closing costs: other costs involved in buying a house, such as legal costs and various taxes

Deposit: an initial installment toward the total cost of the house

Escrow account: a savings account managed by the finance company into which the weekly installments toward the annual insurance premium and annual real-estate tax payment are deposited, and from which the annual insurance premium and the annual real-estate tax payment are paid

Interest: a cost of borrowing money, computed as a fraction of the amount owing

Mortgage: a loan in which real estate is pledged as security for the loan

P & I: abbreviation for “principal and interest”

Points: a cost of borrowing money, computed as a fraction of the total amount borrowed

Principal: the lump sum borrowed

Principal and interest: an installment payment consisting of the interest plus the fraction of the principal for that installment

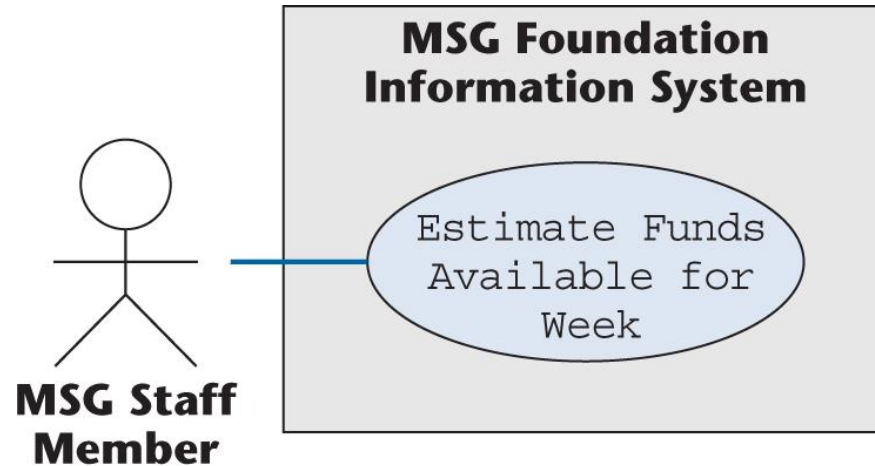
Initial Business Model

- At the start of each week, MSG estimates **how much money will be available** that week to fund mortgages
- **Low-income** couples **can apply** at any time
- An **MSG Foundation** staff member determines:
 - Whether the applicant qualifies for an MSG mortgage
 - Whether MSG has sufficient funds on hand to purchase the home
- If so, the mortgage is granted to the applicant

Initial Business Model

- The **weekly mortgage** repayment is **computed** according to MSG rules
- The **repayment** amount is **computed** and may vary from week to week, depending on the people's current income
- There are 4 **use cases**
 1. Estimate Funds Available for Week
 2. Apply for an MSG Mortgage
 3. Compute Weekly Repayment Amount
 4. Manage an Investment

Use Case 1: Estimate Funds Available for Week



Brief Description

The Estimate Funds Available for Week use case enables an MSG Foundation staff member to estimate how much money the Foundation has available that week to fund mortgages.

Step-by-Step Description

Not applicable at this initial stage.

Use Case 2: Apply for an MSG Mortgage



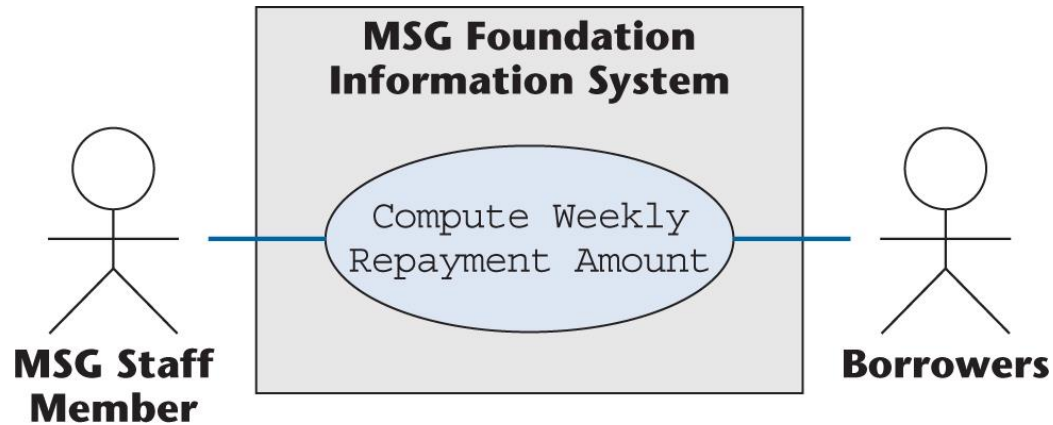
Brief Description

When a couple applies for a mortgage, the Apply for an MSG Mortgage use case enables an MSG Foundation staff member to determine whether they qualify for an MSG mortgage and, if so, whether funds are currently available for the mortgage.

Step-by-Step Description

Not applicable at this initial stage.

Use Case 3: Compute Weekly Repayment Amount



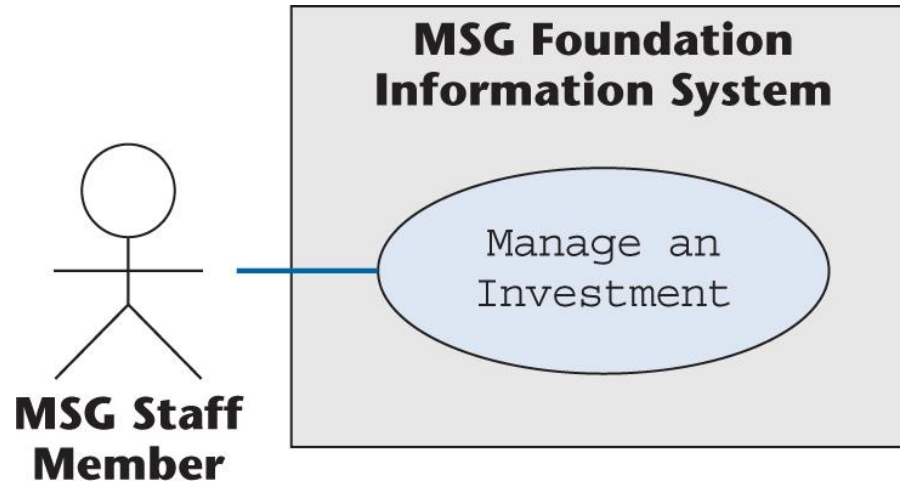
Brief Description

The Compute Weekly Repayment Amount use case enables an MSG Foundation staff member to compute how much borrowers have to repay each week.

Step-by-Step Description

Not applicable at this initial stage.

Use Case 4: Manage an Investment



Brief Description

The Manage an Investment use case enables an MSG Foundation staff member to buy and sell investments and manage the investment portfolio.

Step-by-Step Description

Not applicable at this initial stage.

MSG Case Study Actors

- **Applicants** do not interact with the software product

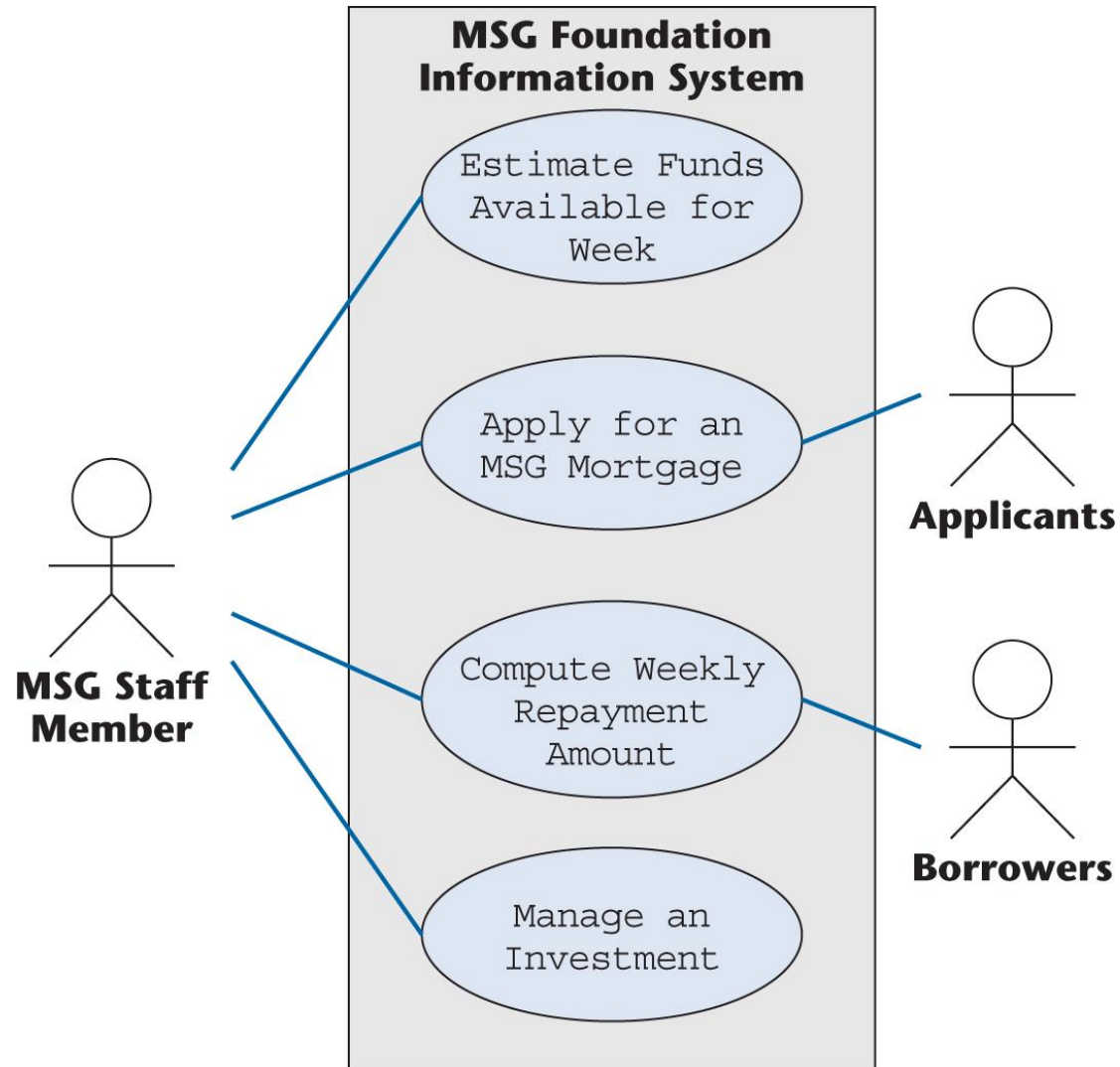
Why is the **Applicant** is considered as an actor in use case **Apply** for an MSG Mortgage?

- The applicants **initiate the use case**
- The applicants **provide the data** entered to the software product by an MSG staff member.
- The **real actor is therefore the Applicant**, while the MSG Staff Member is an agent of the applicants

MSG Case Study Actors

- **Borrower** is an actor in use case Compute Weekly Repayment Amount
 - The use case is initiated by actor **Borrower**
 - The information entered by MSG staff is supplied by the borrower
 - Therefore, **Borrower** is an actor in the use case

Initial Business Model Use Cases



Initial Requirements - Discussion

- It is unclear if the 4 use cases are all requirements of the product to be developed
 - What, exactly, is “a **pilot project**”?
- The best way to proceed is
 - Draw up the initial requirements based on **what the client need**; MSG trustees board needs and then iterate

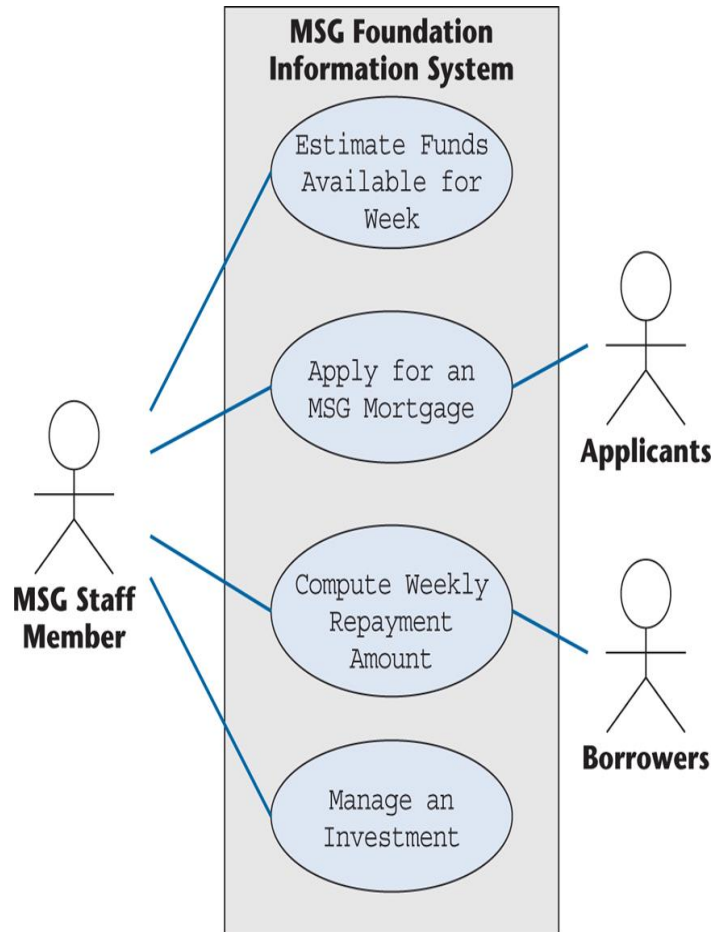
Initial Requirements Refinement

- The pilot project deals with the “**money that is available each week to purchase homes**”
- Consider each use case:
 1. Estimate Funds Available for Week
is obviously part of the initial requirements
 2. Apply for an MSG Mortgage
Doesn't seem to have anything to do with the pilot project, so it is excluded
 3. Compute Weekly Repayment Amount
part of the initial requirements
 4. Manage an Investment
part of the initial requirements
- Some of Funds Available for Week comes from the weekly **repayment** of existing mortgages, and from income of existing **investments**

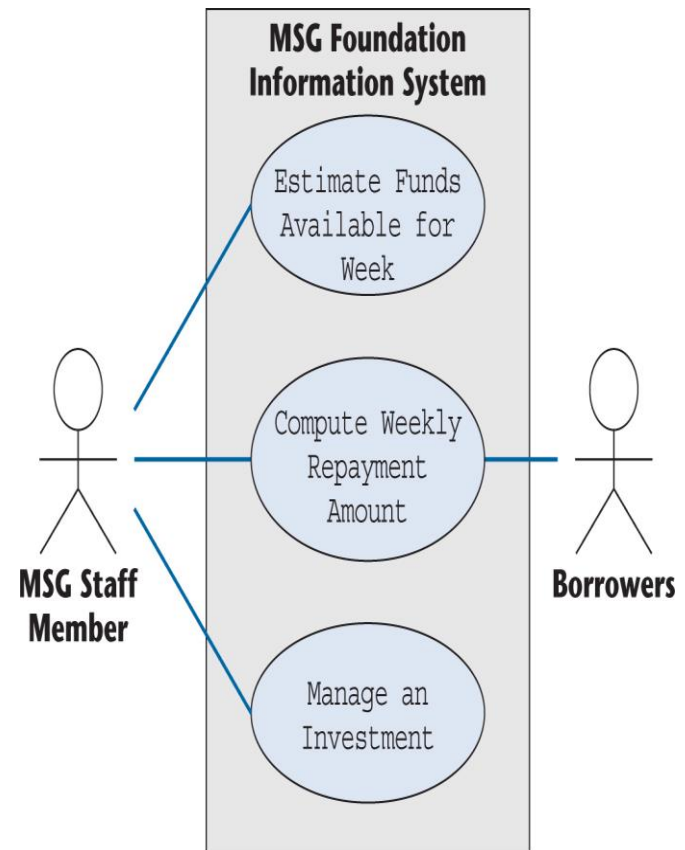
Initial Requirements Refinement

- The resulting use-case diagram after refinement

Old Use Case



Refined Use Case



Initial Requirements Refinement

Mortgage Constraints – Risk Management

- The **systems analysts** learn that the MSG Foundation grants a 100% mortgage to buy a home under the following **conditions**:
 - The couple has been **legally married** for at least 1 year but not more than 10 years
 - Both husband and wife are gainfully **employed**
 - The price of the home must be below **the published median price** for homes in that area for the past 12 months
 - Their income and/or **savings are sufficient** to afford a standard fixed-rate 30-year 90% mortgage
 - The **foundation has sufficient funds to purchase the home**

Initial Requirements Refinement

- If the **application is approved**, then each week for the next 30 years, the **couple pays MSG**
 - The total of the **principal and interest payment** never changes over the life of the mortgage, plus
 - The **escrow payment**, which is $1/52$ of the sum of the annual real-estate tax and the annual homeowner's insurance premium
- If weekly payment **exceeds 28%** of the couple's gross weekly income, **MSG pays the difference as a grant**
 - The couple must provide **proof of their current income**, the weekly payment may vary from week to week

Fund Available for Week Computations

1. At the beginning of the week, the estimated annual **income** from MSG investments is computed and divided by 52
2. The estimated annual MSG **operating expenses** are divided by 52
3. The estimated **mortgage repayments** for the week is computed
4. The estimated **grants** for the week is computed
5. The **amount available** at the beginning of the week is computed as $(1) - (2) + (3) - (4)$
6. If the cost of the home is **no more than amount available at (5), funds are provided** to the applicant for buying the house
7. At the end of each week, **unspent funds are invested**

Requirements of the MSG Pilot Project

- To keep the **cost of the pilot project as low as possible**, only those data items needed for the weekly fund's computation will be included:
 - Investment data
 - Operating expenses data
 - Mortgage data

Investment Data

Investment details:

- Investment number
- Investment name
- Investment Estimated annual return
- Date when estimated annual return was last updated

Operating Expenses Data

Operating Expenses details:

- Estimated annual operating expenses
- Date when estimated annual operating expenses was last updated

Mortgage Details

- Account number
- Last name of mortgagees
- Original purchase price of home
- Date mortgage was issued
- Weekly principal and interest payment
- Current combined gross weekly income
- Date combined gross weekly income was last updated
- Annual real-estate tax
- Date annual real-estate tax was last updated
- Annual homeowner's insurance premium
- Date annual homeowner's insurance premium was last updated

MSG Pilot Project Requirements - Reports

- Three **types of reports** are needed:
 - The results of the funds computation for the week
 - A list of all investments (to be printed on request)
 - A list of all mortgages (to be printed on request)