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## A Systems Approach to Increasing LMU Undergraduate Gym Attendance

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A Systems Approach to Increasing LMU Undergraduate Gym Attendance

by

Timothy O'Rourke

A capstone presented to the

Faculty of the Department of  
Systems Engineering  
Loyola Marymount University

In partial fulfillment of the  
Requirements for the Degree  
Master of Science in Systems Engineering

April 26, 2022



Loyola Marymount  
University

# A Systems Approach to Increasing LMU Undergraduate Gym Attendance

**SYEG 696 Capstone**

Timothy O'Rourke  
B.S. Mechanical Engineering  
M.S. Systems Engineering Candidate  
April 26, 2022



# Inspiration

## 1. Important lessons and values:

- Confidence
- Teamwork
- Discipline
- Patience
- Body awareness
- Persistence
- Happiness
- The value in pain
- Health

## 2. Attendance fall off

## 3. Desire to ease this personal concern

## 4. Recognition of nationwide problem

## 5. Potential business venture



# Agenda



## Acknowledgements

Purpose

Executive Summary

Methodology

Background

Problem Statement

Scope

Stakeholders

Measures of Effectiveness

Requirements & Verification

Identification of Alternatives

Recommended Alternative

Solution Architecture

Implementation Plan

Verification & Validation Plan

Risk Management

Ethical Considerations

Conclusions & Recommendations

Further Research

Learning Outcomes



# Acknowledgements



## Elham Ghashghai

- Clinical Professor of Systems Engineering
- Technical & Project Capstone Advisor

## Gustavo Vejarano

- Graduate Program Director

## John Poladian

- Lecturer in Systems Engineering

## Andy Black

- Director, Campus Recreation and Student Facilities

## Dr. B.J. Johnson

- Graduate Program Director and Clinical Assistant Professor of Computer Science

Thank you all for your support!

# Purpose

This review is fulfilling a requirement for SYEG 696 (Systems Engineering Integrative Project/Thesis). Ensures a sufficient understanding and mastery of the Systems Engineering process.

CAPSTONE  
PROJECT



Define problem statement



Define project scope



Evaluate solutions against MOEs and requirements



Validate solution



Results and conclusions



# Executive Summary

## Background:

- >75% of US Adults Don't Exercise Enough
- Gym, Fitness Center, and Health Club attendance increases aerobic and anaerobic physical activity levels.

## Problem Statement:

- Due to lack of motivation, education, and free time, the Burns Recreation Center sees only 20% of LMU undergraduate students daily during academic terms.

## Methodology:

- Systems Engineering Methodology will be employed to exercise the identified opportunity.

## Opportunity:

- Reduction in cost of healthcare

## Recommendations:

- LMU specific mobile app to be developed to motivate, educate, and inspire.



# Methodology

Problem Definition

Scope

Identification of Stakeholders

Measures of Effectiveness

Develop Requirements

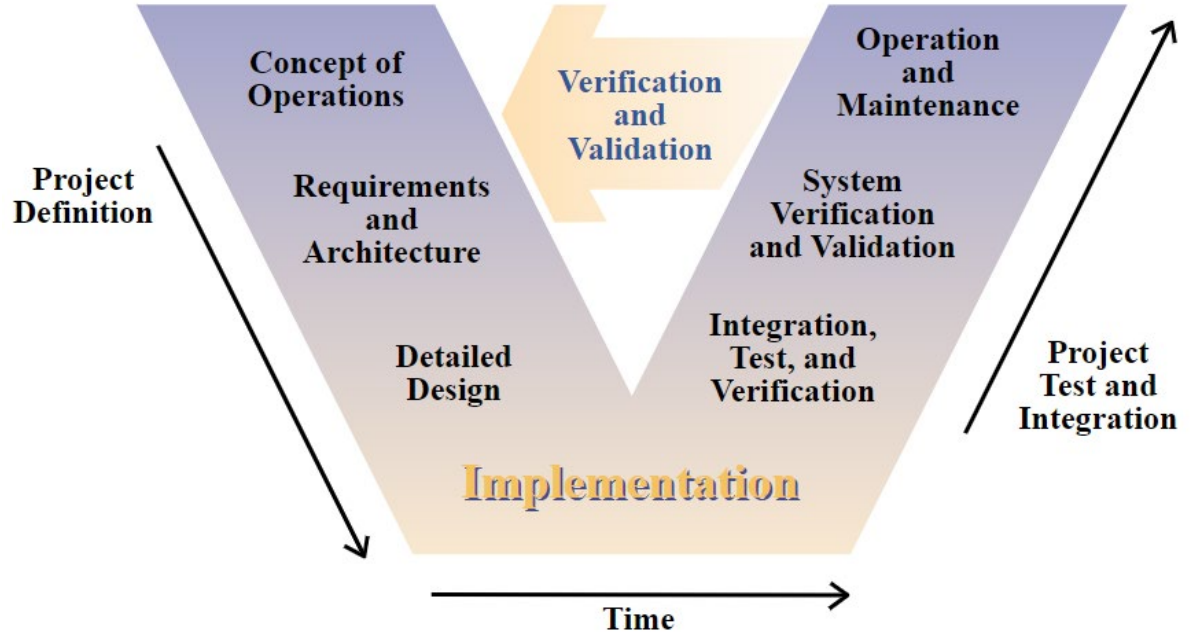
Identification of Alternatives

Assessment of Alternatives

Systems Architecture

Risk Management

Verification/Validation Plan



**Systems Engineering Methodology will be employed to exercise the identified opportunity.**



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# >75% of US Adults Don't Exercise Enough

- **53.3%** of adults aged 18 and over **meet** the Physical Activity Guidelines for **aerobic** physical activity [1]
- **23.2%** of adults aged 18 and over who **meet** the Physical Activity Guidelines for both **aerobic** and **muscle-strengthening** activity [1]

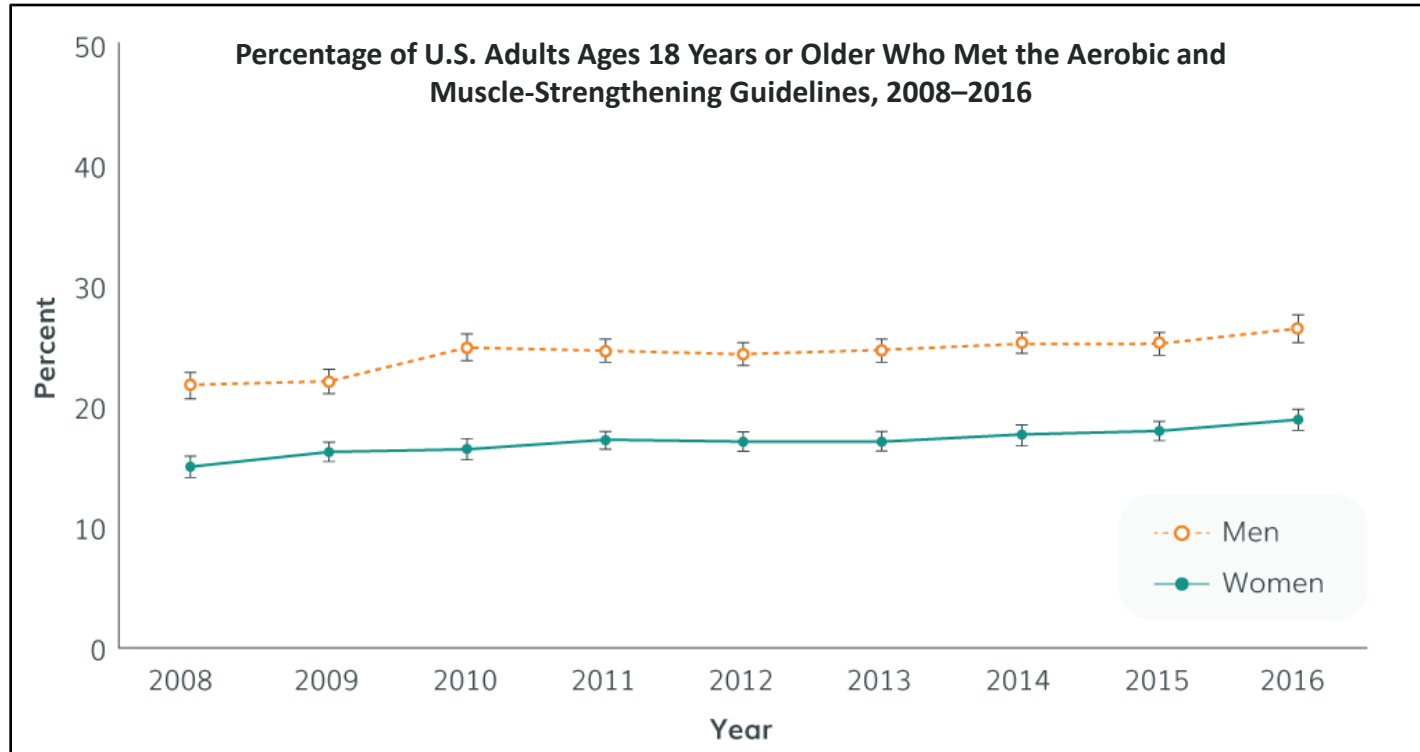


Figure Source: [1]

# Gym Membership is Directly Related to Activity Levels

- Health club membership is associated with significantly increased aerobic and resistance physical activity levels compared to non-members [2]

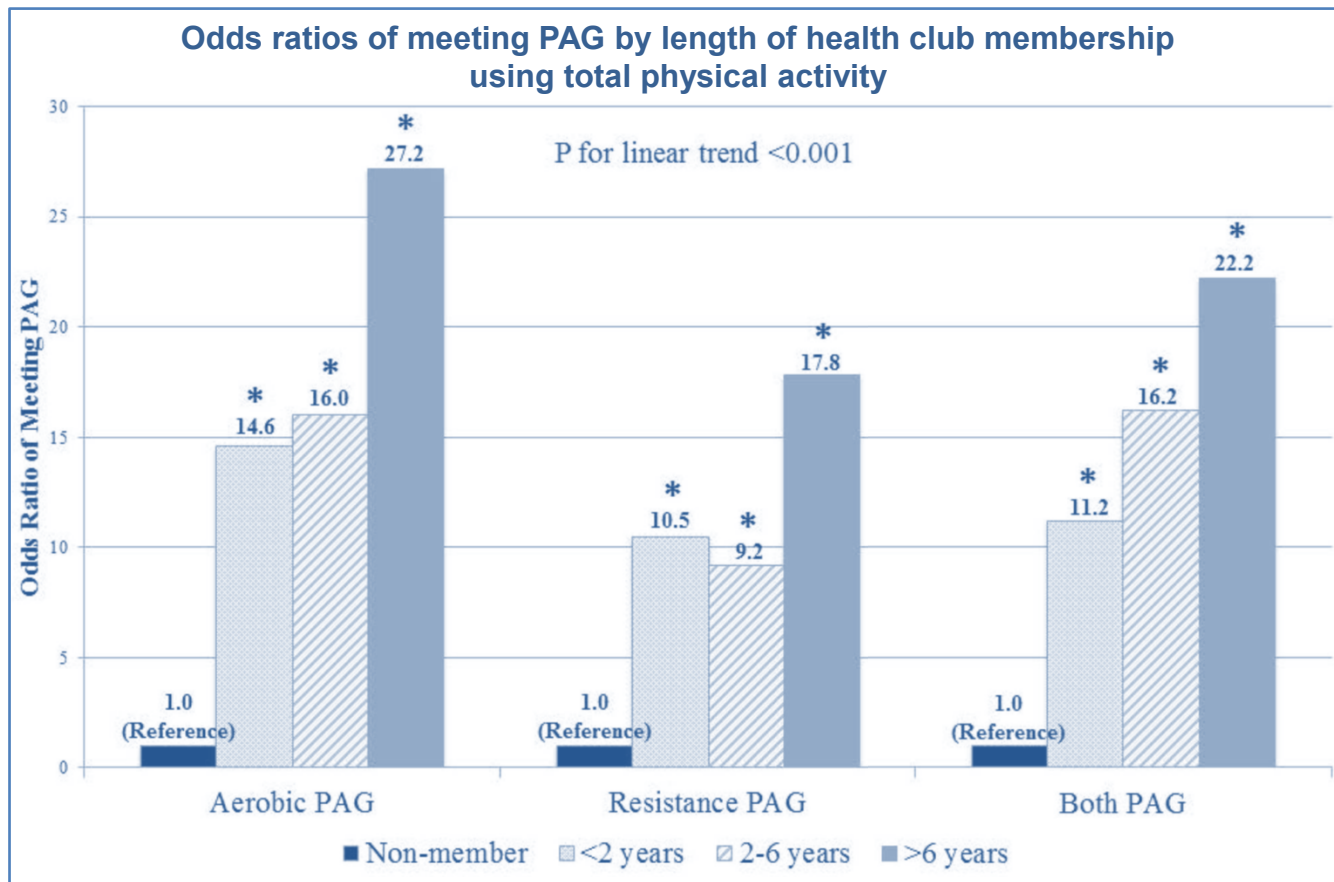


Figure Source: [2]



# Opportunity

Health club members vs. non-members:

- More favorable cardiovascular health [2]
- Reduced risk of developing type 2 diabetes and cardiovascular disease [3]
- Lower odds of obesity and abdominal obesity [2]
- Increased physical activity levels [2]

<b>Economic Costs of Chronic Diseases and Risk Factors</b>		
<b>Disease/Risk Factor</b>	<b>Healthcare Costs</b>	<b>Timeframe</b>
Heart Disease/Stroke	\$214 Billion [4]	Annually
Diabetes	\$237 Billion [5]	Annually
Obesity	\$147 Billion [6]	Annually
Lack of Physical Activity	\$117 Billion [7]	Annually

Gym attendance may reduce healthcare costs



# National Physical Activity Plan

## Sectors and Roles

NPAP Sector	Role
Business and Industry	- Encouragement from Employers - Provide facilities and encourage use
Community, Recreation, Fitness, Parks	- Provides places for active recreation - Playgrounds, hiking/biking trails, sports fields, swimming pools - Can provide exercise programs
Education	- Lead role in providing physical activity in education settings - Physical education, after-school sports, school facilities
Faith-based Settings	- Provide places for physical activity - Promotion through outreach activities
Health Care	- Can assess, counsel, and advise on physical activity - Can partner with other sectors to promote activity programs
Mass Media	- Can provide easy to understand messages about health benefits of physical activity - Can also promote information about facility locations
Public Health	- Can take lead in setting objectives and coordinating activities among sectors
Sports	- Provides organized opportunities for physical activity - Conducted in a manner that reduces risk of injuries
Transportation, Land Use, Community Design	- Designs and implements activity friendly routes to everyday destinations - Can improve access to places for physical activity such as parks
Defined by: US Department of Health and Human Services [8]	

- 9 Sectors
- All sectors encourage physical activity in some variety
- No sector is focused in educating people on how to use a gym
- Education sector could improve on gym education and motivation

Project will focus on education sector



# Why Don't We Exercise?

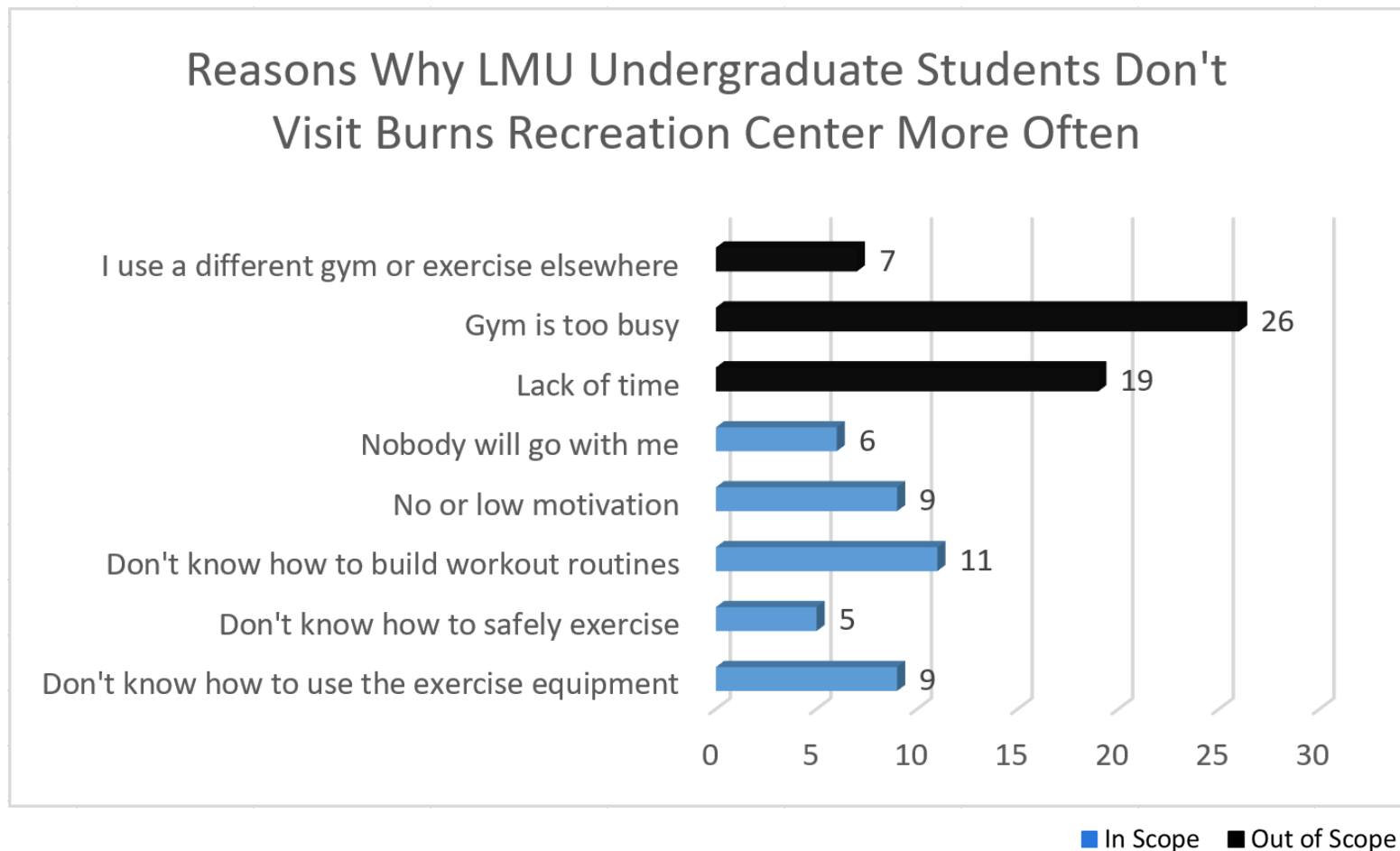
A stylized icon of a person running, rendered in a light blue color, enclosed within a circular border. The person is depicted in a dynamic, forward-leaning posture with one leg extended back and arms pumping, symbolizing physical activity.

Factors negatively associated with adult physical activity include [1,9,10]:

- Too old
- Don't know how
- Too expensive
- Lack of time
- Low motivation
- Gym Accessibility
- Too demanding/difficult
- Too out of shape
- Being disabled
- Gym is too busy

Project will focus on “Don't know how” & “Low motivation”

# Justifications of LMU Undergraduate Students



“Don’t know how” & “Low motivation” factors are valid issues

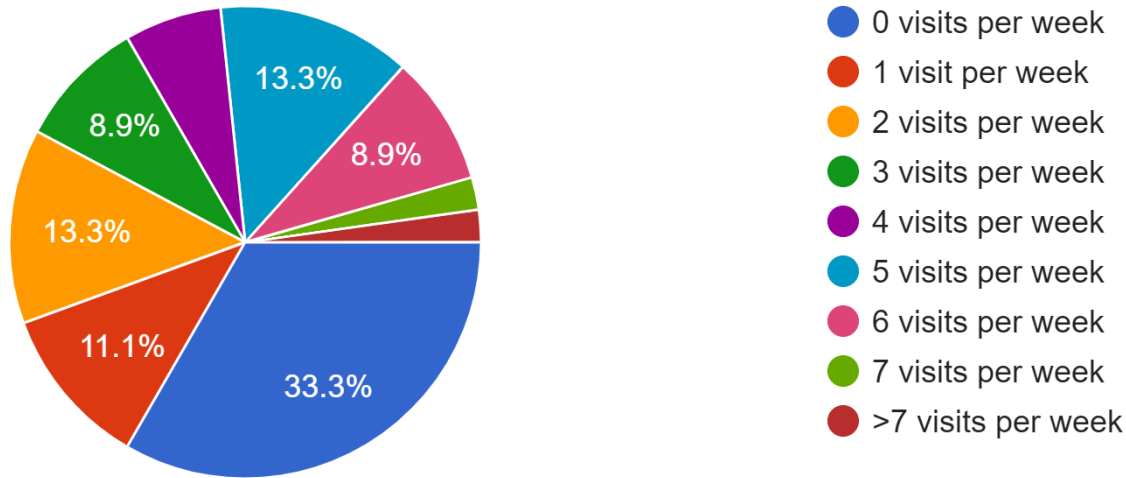




# LMU Undergraduate Student Gym Attendance

On average during the school semester, how often do you visit LMU's Burns Recreation Center?  
(please be honest & accurate)

45 responses



>50% visit the school gym 2 times or less per week

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# Problem Statement

Due to lack of motivation, education, and free time, the Burns Recreation Center sees only 20% of LMU undergraduate students daily during academic terms.

- Objective is to increase undergraduate student attendance to LMU’s gym.

### Average undergrad. visits per day [11]:

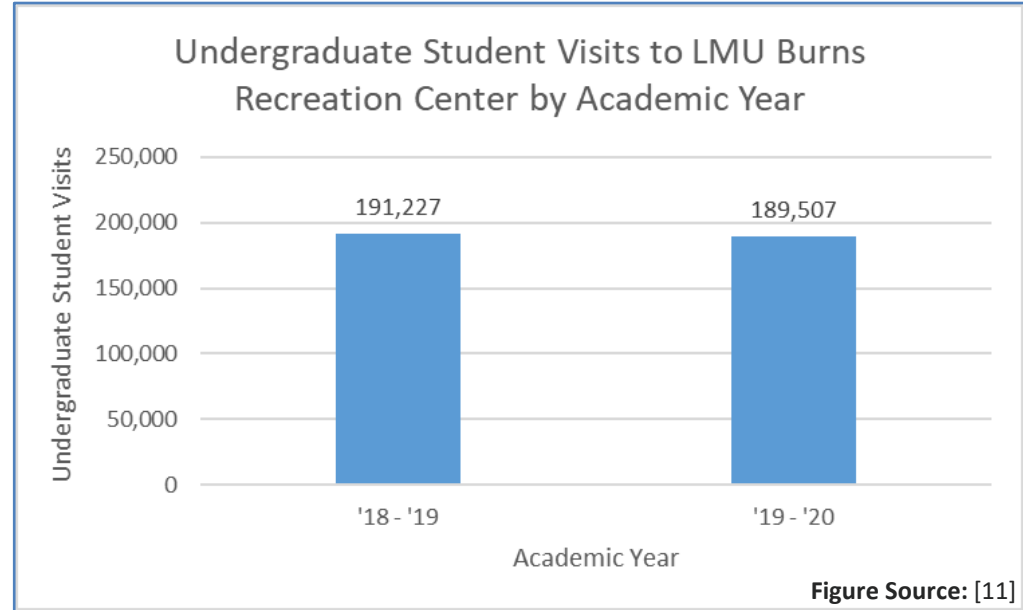
- ~1300 (~20%)
- 49% male and 51% female

### Total undergrad. Students (2021) [11]:

- 6564

### Attend the gym at least once per semester [11]:

- ~3940 (~60%)



Attendance Frequency by Academic Month [11]								
Month	Jan	Feb	Mar	Apr	Sep	Oct	Nov	Dec
Attendance	High	High	Lower	Lower	High	High	Lower	Lower

# Scope

- LMU Burns Recreation Center
- LMU Undergrad. Students
- Education NPAP Sector
- Costs
- Factors to address:
  - Don't Know How
  - Low Motivation

In scope



- All other gyms
- Non-LMU population
- LMU Graduate Students, Faculty, and Staff
- All other NPAP Sectors
- Increasing people meeting PAG
- All other negative factors

Out of Scope





# Factors To Be Addressed

## Don't know how to workout at the gym:

- Results in:
  - Feeling out of place
  - Not going to the gym in general
  - Intimidation
  - Not knowing what to do there
  - Need for guide or instructor

## Low Motivation:

- Results in:
  - Not going to the gym in general
    - Low energy
    - Ineffective use of time

Primary Reasons to Stop Gym Membership in the United States 2017

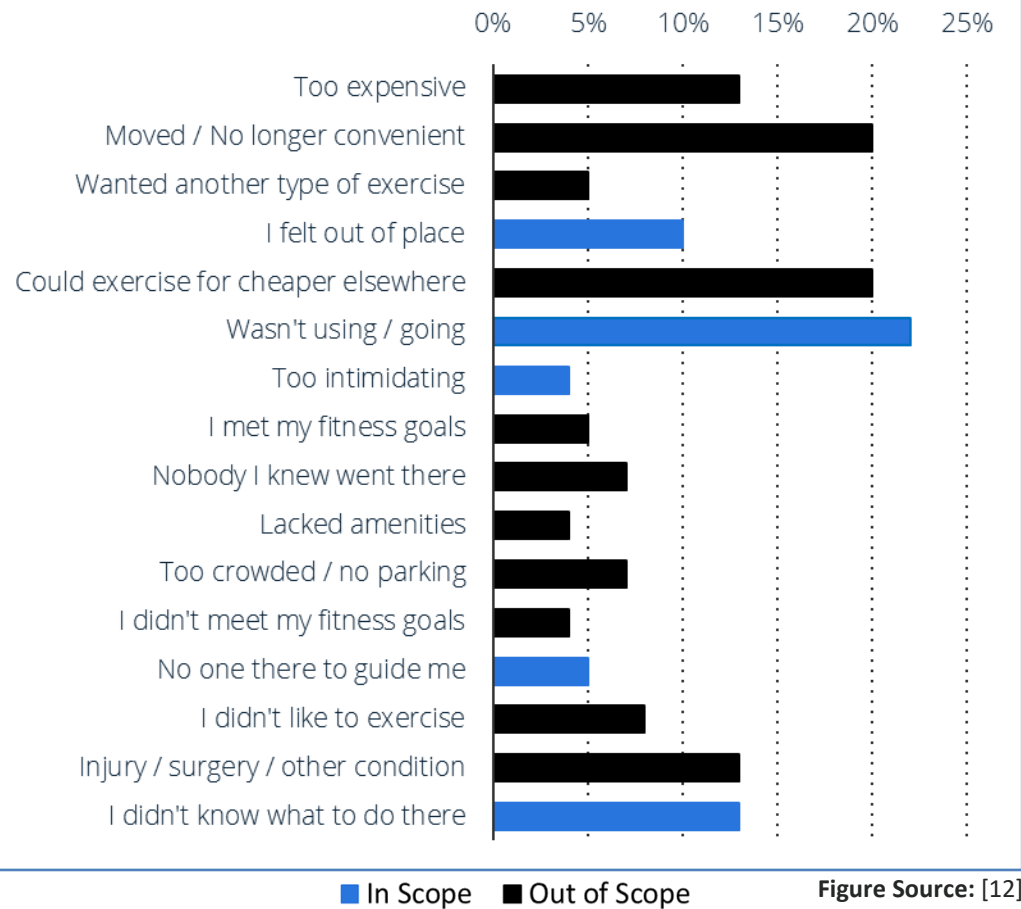


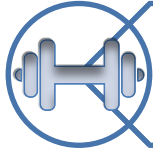
Figure Source: [12]

# Stakeholders

Level of Importance ↑



LMU Undergraduate Students



LMU Campus Recreation and Student Facilities



LMU Department of Health and Human Sciences



Centers for Disease Control and Prevention



Health Industry



Insurance Companies

# Stakeholder Analysis



- LMU Campus Recreation & Student Facilities
- LMU Department of Health & Human Sciences

- LMU Undergraduate Students

- Health Industry
- Insurance Companies

- Centers for Disease Control & Prevention

Priority of stakeholder needs is understood

# Measures of Effectiveness (MOEs)

- Gym attendance frequency
- Quantity of gym attendees
- Cost per visit





# Proposed Requirements & Verification Methods

ID	Requirement	Criteria	Verification Method	Pass/Fail
<b>General Requirements</b>				
1	The system shall be accessible to all LMU undergraduate students	=0 inaccessible	Inspection	*
2	The system shall be user friendly	<5 min explanation to understand	Demo	*
3	The system shall be capable of tracking user metrics	>5 metrics tracked	Demo	*
4	The system shall protect all user data and metrics	=0 metrics spilled	Test	*
<b>Educational Requirements</b>				
5	The system shall provide gym education to all users	>1 education mechanism	Demo, Test	*
6	Gym education shall consist of 1-building workouts, 2-performing exercises, and 3-avoiding injury	Meets 1, 2, & 3 education types	Inspection	*
<b>Motivational Requirements</b>				
7	The system shall motivate gym attendance to all users	>1 motivation mechanism	Demo, Test	*
8	The system shall provide extrinsic incentives to users as means of motivation to attend the gym [16]	>1 material reward available	Inspection	*
<b>Cost Requirements</b>				
9	The system shall be free to LMU undergraduate students	Student cost =\$0	Inspection	*
10	The system shall gain gym visits for a cost of less than \$2.00 per visit [13,14]	<\$2.00 per visit	Demo, Test	*

Solution shall be designed to meet all requirements



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Learning Outcomes

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# Identification of Alternatives

Successful solution alternatives shall:

- Address the problem statement
- Comply with system requirements
- Have a positive impact on MOEs
- Remain in scope
- Benefit stakeholders

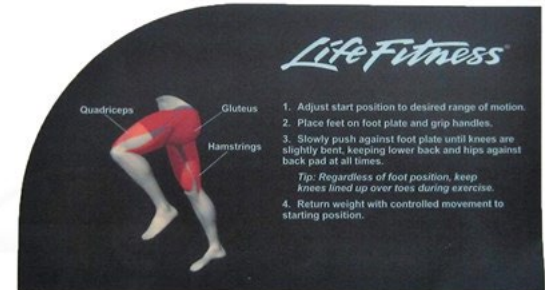


A trade study will be executed to determine best alternative



# LMU Methods

- F45 Training Center [11]
  - Motivation/Education
- Placard Decals [11]
  - Education
- Gym Employee Instruction (if asked) [11]
  - Education
- Weight Lifting Club [11]
  - Motivation/Education
- Group Exercise Classes [11]
  - Motivation



LMU Methods will not be considered as potential alternatives



# Overview of Identified Alternatives



- **Do Nothing**
  - No action
- **Financial Incentives**
  - Trade \$ for attendance
- **Reward motivation**
  - Trade items for attendance
- **Education**
  - Trade education for attendance
- **Mobile App**
  - Combination

# Alternative 1 – Rebate Gym Membership Fees

## Description:

- After a 50 gym attendance threshold is met, the gym membership fees will be credited back to the student
- Make parents/student sponsors aware for cost savings
- LMU Undergrad. Students pay \$85 a semester for the gym

Strengths	Weaknesses	Opportunities	Threats
<ul style="list-style-type: none"> <li>• &lt;\$1.70/visit</li> <li>• Financial motivation</li> <li>• 20% increase in gym attendance [13]</li> </ul>	<ul style="list-style-type: none"> <li>• No gym education</li> </ul>	<ul style="list-style-type: none"> <li>• Rebate in the form of bookstore credit or tuition credit</li> <li>• Increased motivation from parents and/or sponsors</li> </ul>	<ul style="list-style-type: none"> <li>• Increase in membership fees</li> </ul>

# Alternative 2 – Lottery Based Financial Incentives

## Description:

- Every time a student enters the gym, a random lottery will be spun to win a \$20 Amazon gift card
- Odds of winning could be defined as 1:100

Strengths	Weaknesses	Opportunities	Threats
<ul style="list-style-type: none"><li>• ~\$0.20/visit</li><li>• Financial motivation</li><li>• 40% increased probability of gym attendance [14]</li></ul>	<ul style="list-style-type: none"><li>• No gym education</li><li>• Not a large financial incentive</li></ul>	<ul style="list-style-type: none"><li>• Various prizes other than gift cards could be offered</li></ul>	<ul style="list-style-type: none"><li>• Not enough attendance could drive up cost/visit</li></ul>

# Alternative 3 – Workouts & Smoothies

## Description:

- After five gym visits, a free smoothie/protein shake can be claimed

Strengths	Weaknesses	Opportunities	Threats
<ul style="list-style-type: none"><li>• &lt;\$2.00/visit</li><li>• Reward motivation</li><li>• Provides healthy nutrition</li></ul>	<ul style="list-style-type: none"><li>• No gym education</li><li>• Dietary restrictions</li></ul>	<ul style="list-style-type: none"><li>• Could deviate from shakes to meals</li></ul>	<ul style="list-style-type: none"><li>• Increased cost of ingredients</li></ul>



# Alternative 4 – Spin The Wheel

## Description:

- Every 20<sup>th</sup> visit, a wheel can be spun to win school swag/merch
- Swag/merch could range from protein shakers to sweaters

Strengths	Weaknesses	Opportunities	Threats
<ul style="list-style-type: none"><li>• &lt;\$2.00/visit</li><li>• Reward motivation</li><li>• Caters to many individuals</li></ul>	<ul style="list-style-type: none"><li>• No gym education</li><li>• Upset users if don't get desired prize</li></ul>	<ul style="list-style-type: none"><li>• Prize variety</li></ul>	<ul style="list-style-type: none"><li>• Most expensive item won more frequently</li></ul>

# Alternative 5 – Affiliate Trials

## Description:

- Every 20<sup>th</sup> visit, the student could pick a free trial day from a list of local affiliate gyms
- These gyms could consist of rock climbing, kickboxing, CrossFit, etc.

Strengths	Weaknesses	Opportunities	Threats
<ul style="list-style-type: none"><li>• Reward motivation</li><li>• Gym education</li><li>• Time flexible</li><li>• Caters to many</li></ul>	<ul style="list-style-type: none"><li>• Likely expensive</li><li>• Travel required</li></ul>	<ul style="list-style-type: none"><li>• Partner with local gyms</li></ul>	<ul style="list-style-type: none"><li>• No desire for affiliate gyms</li><li>• Affiliates raising prices</li></ul>

# Alternative 6 – Recorded Classes/Workouts

## Description:

- LMU gym has workout rooms that host a variety of classes
- During the time slots where no classes are hosted, students could utilize and select prerecorded workouts and classes.

Strengths	Weaknesses	Opportunities	Threats
<ul style="list-style-type: none"><li>• Gym education</li><li>• Time flexible</li><li>• Social motivation</li><li>• Low cost</li></ul>	<ul style="list-style-type: none"><li>• Low availability</li><li>• Sanitation concerns</li></ul>	<ul style="list-style-type: none"><li>• Sign in remotely for virtual classes</li></ul>	<ul style="list-style-type: none"><li>• Too much demand</li></ul>

# Alternative 7 – Personal Trainers

## Description:

- LMU offers a limited number of personal training sessions free of charge to students per semester
- Students would book their appointments with the trainers throughout the semester

Strengths	Weaknesses	Opportunities	Threats
<ul style="list-style-type: none"><li>• Wholesome gym education</li><li>• Personalized</li><li>• Social motivation</li></ul>	<ul style="list-style-type: none"><li>• Very expensive</li><li>• Not effective for everyone</li><li>• Shy individuals</li></ul>	<ul style="list-style-type: none"><li>• Trainers based on specialty</li></ul>	<ul style="list-style-type: none"><li>• Pandemics</li></ul>

# Alternative 8 – Community Specific Mobile App

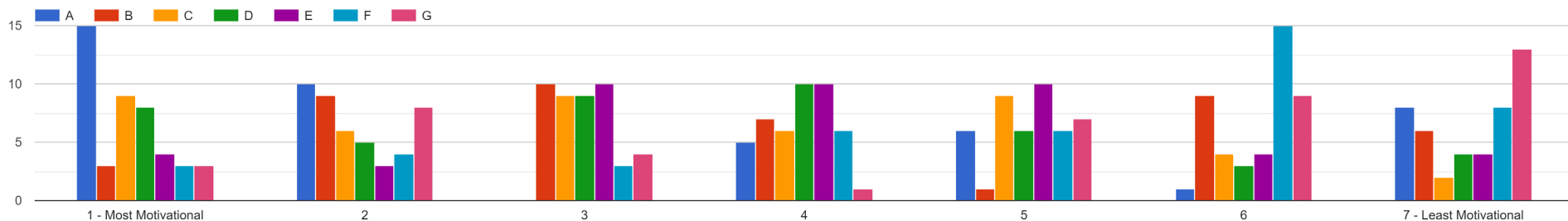
## Description:

- LMU specific mobile app designed to build a local community while incentivizing gym attendance while providing gym education
- Incorporates a point system
  - Points earned via attendance
  - Spent on a variety of options
- Educates how to safely use every piece of LMU gym equipment

Strengths	Weaknesses	Opportunities	Threats
<ul style="list-style-type: none"> <li>• Incentive motivation</li> <li>• Gym education</li> <li>• Social motivation</li> <li>• Accessibility</li> <li>• Control cost/visit</li> </ul>	<ul style="list-style-type: none"> <li>• Expensive development</li> <li>• User effort required</li> </ul>	<ul style="list-style-type: none"> <li>• Many features could be added</li> <li>• Could include many incentives</li> <li>• Regulate attendance</li> </ul>	<ul style="list-style-type: none"> <li>• Gym redesign requiring app update</li> <li>• Cyberbullying</li> </ul>

# Survey Results Factored Into Trade Study

Rank the following from most motivational (1) to least motivational (7).



Please use the following descriptions for reference:

- A - Rebate of gym membership fees after meeting attendance threshold
- B - 1% chance of winning a \$20 gift card upon every visit
- C - LMU providing limited personal training sessions
- D - Receiving a free smoothie/protein shake every 5th visit
- E - Spin the wheel to win school swag/merch every 20th visit
- F - Having access to recorded classes and workouts
- G - Earning a free trial day at nearby popular gyms every 20th visit

**Most**  
**2nd**  
**5th**  
**4th**  
**3rd**  
**6th**  
**Least**

# Evaluation Matrix (AOA)

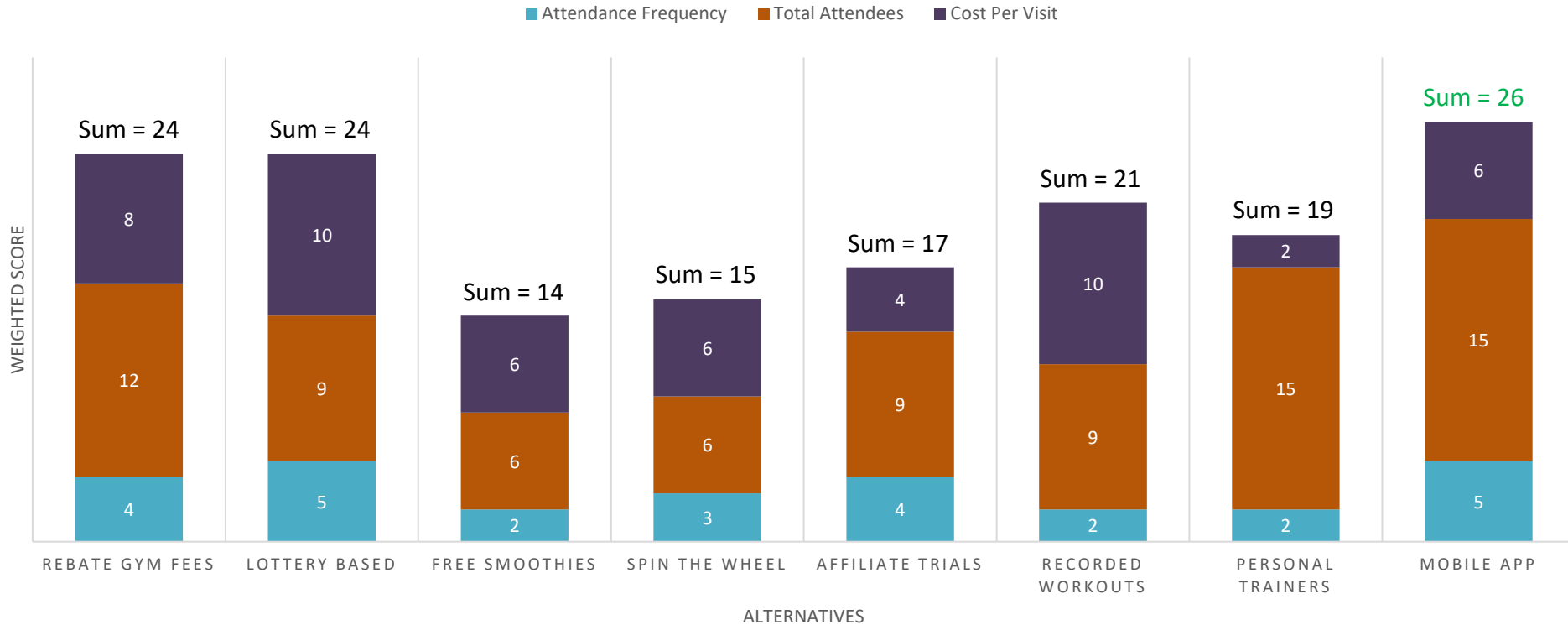
Alternatives	Measures of Effectiveness						Weighted Sum
	Attendance Frequency		Total Attendees		Cost Per Visit		
	WF = 1		WF = 3		WF = 2		
	U	W	U	W	U	W	
1) Rebate Gym Fees	4	4	4	12	4	8	24
2) Lottery Based	5	5	3	9	5	10	24
3) Free Smoothies	2	2	2	6	3	6	14
4) Spin the Wheel	3	3	2	6	3	6	15
5) Affiliate Trials	4	4	3	9	2	4	17
6) Recorded Workouts	2	2	3	9	5	10	21
7) Personal Trainers	2	2	5	15	1	2	19
8) Mobile App	5	5	5	15	3	6	26

Alternative 8, Mobile App, should be selected



# Evaluation Results (AOA)

## WEIGHTED SCORE VS. ALTERNATIVES



The path forward will be a community specific mobile app





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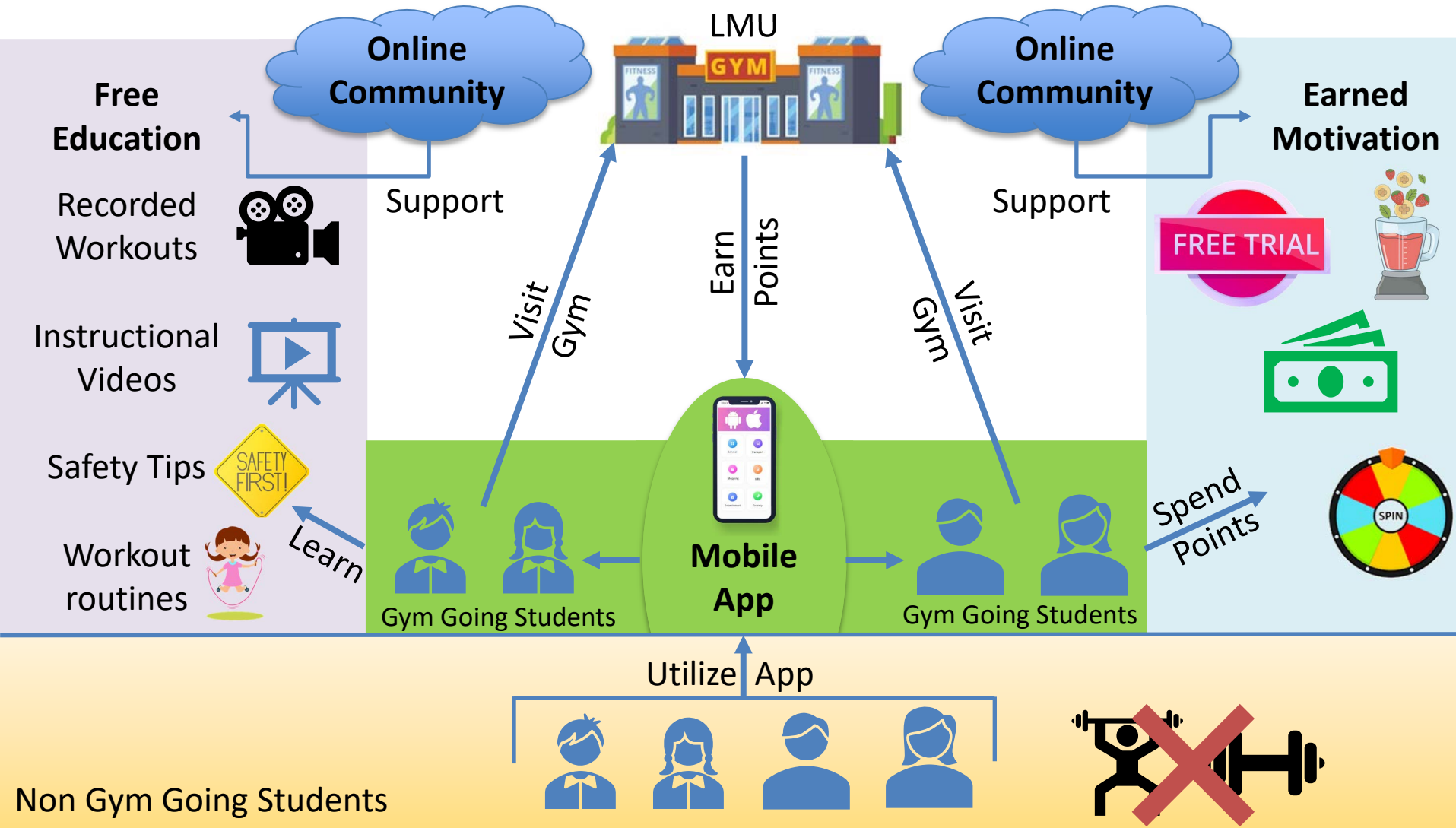
Conclusions & Recommendations

Further Research

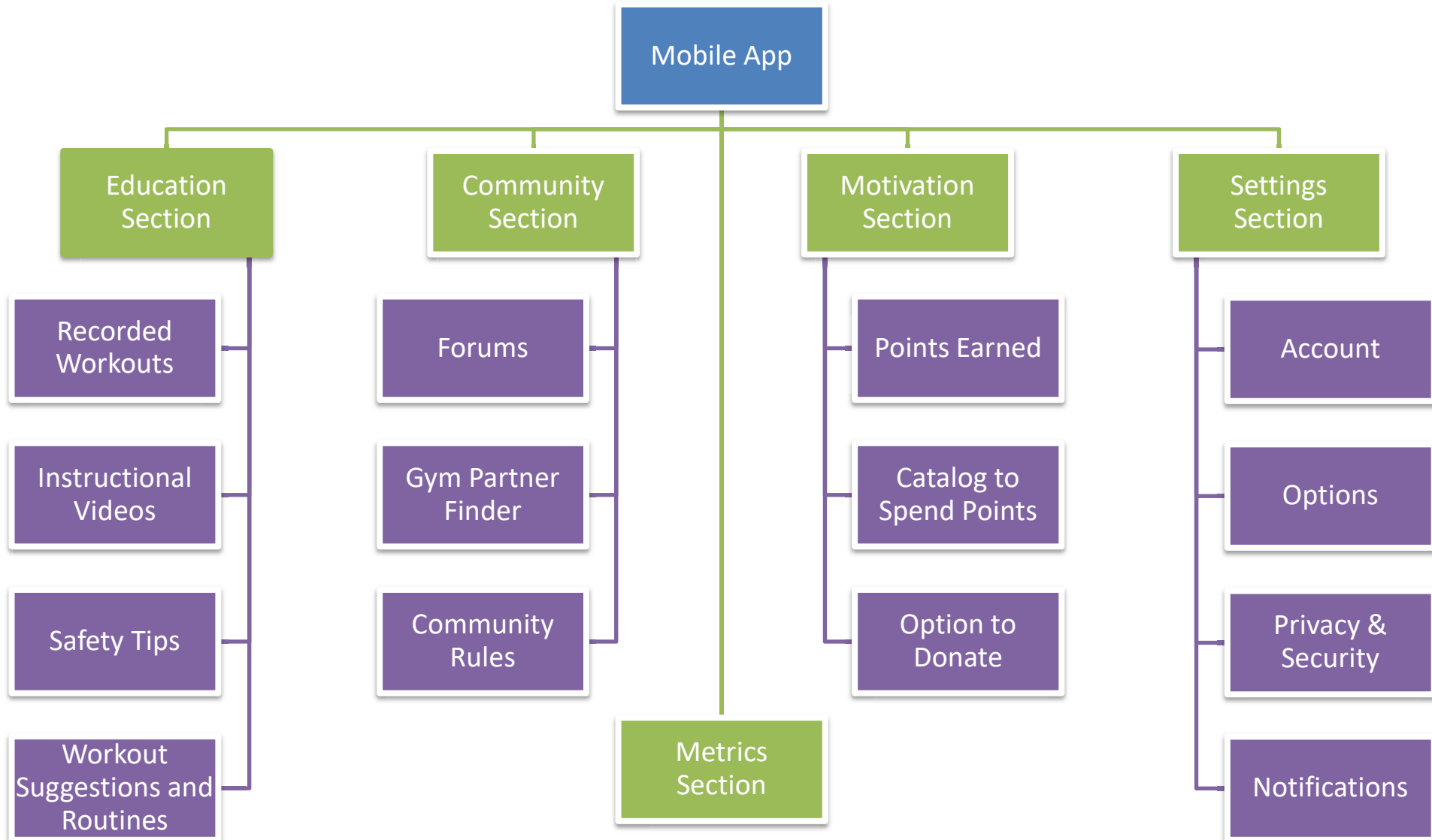
Learning Outcomes



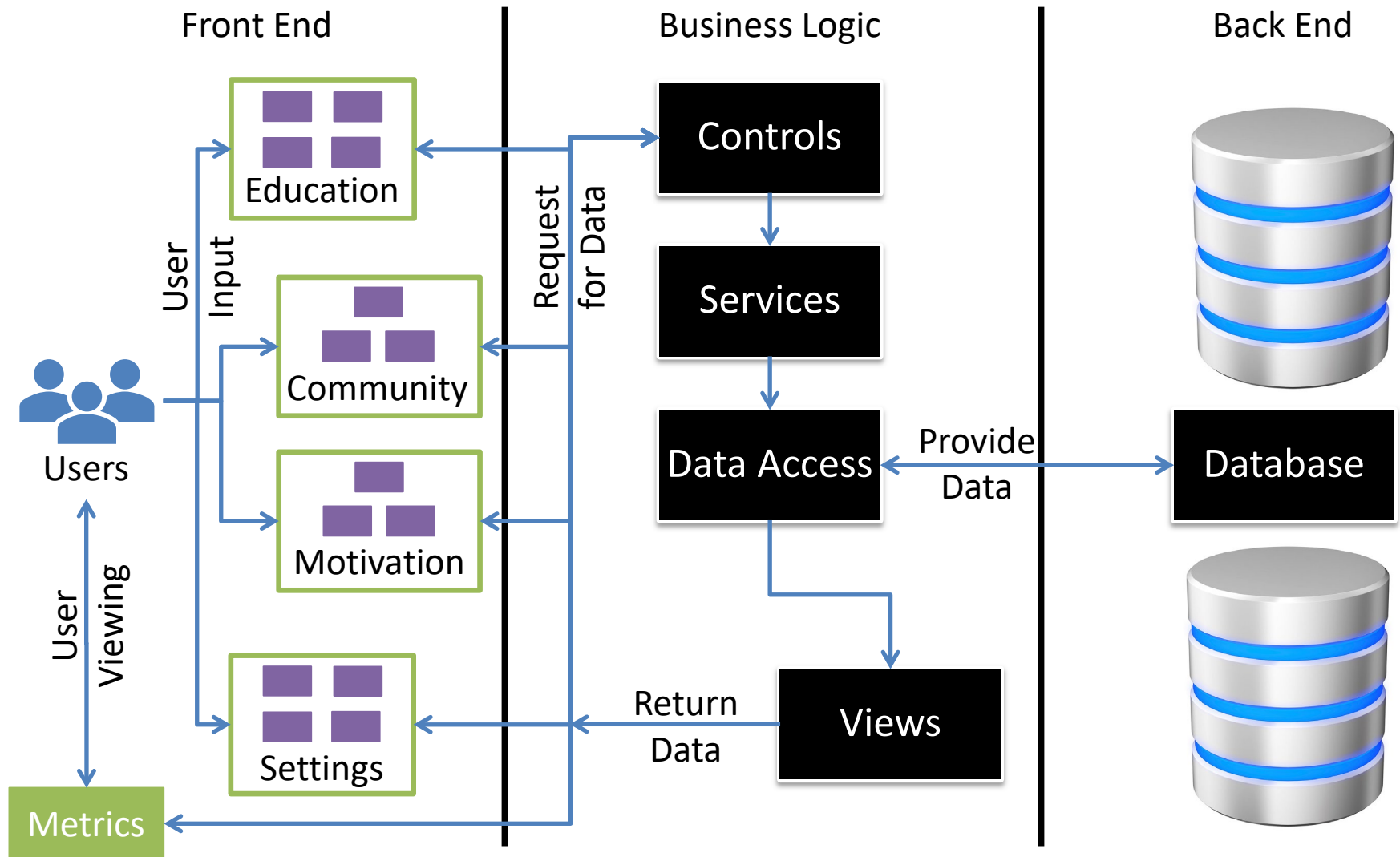
# Solution Architecture – Operational View




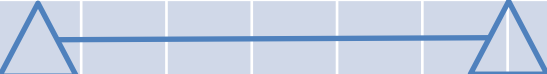


# Solution Architecture – Systems View



# Solution Architecture – Data View



# Implementation Plan

Stage	Month												Year				Status		
	1	2	3	4	5	6	7	8	9	10	11	12	2	3	4	5			
Concept																		Green	
Development																Not Started			
Implementation																	Not Started		
Utilization and Support																			Not Started
Retirement																		Not Started	

Opportunity for computer science capstone project at LMU

# Verification Plan

- Verification can be completed via various methods.
  - Test                      - Demo
  - Analysis                 - Inspection
- Analysis can be completed before product has been built.
- Test, demonstration, and inspection begins once the product has been procured and implemented.
- Verification artifacts will be created and stored.

All artifacts will be delivered to customer at completion



# Validation Plan

- With stakeholders, conduct a formal review to ensure all objectives and goals have been fulfilled
  - If action items arise:
    - Incorporate feedback or adjudicate
    - Iterate validation review with stakeholders
- The scope of the validation plan review is dependent on
  - The life cycle
  - Progress within cycle
- Validation may be completed on:
  - The full system
  - A system element
  - An artifact (ConOps, prototype, etc.)
  - Delivered system



# Risk Management

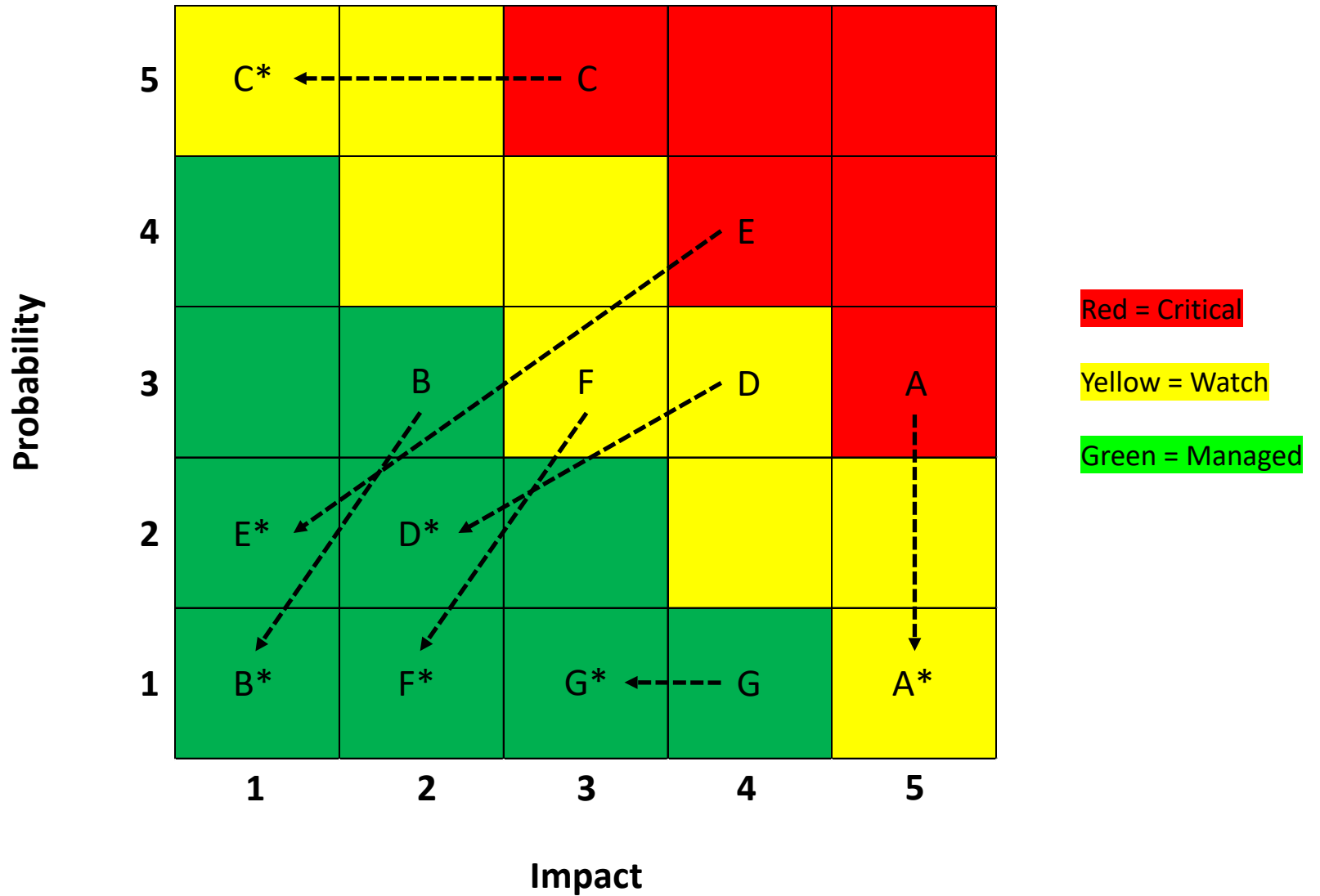
Red = Critical  
 Yellow = Watch  
 Green = Managed

Risk ID	Description	Impact	Probability	Mitigation Plan	Mitigated Impact	Mitigated Probability	Expected Status
A	Security breaches	5	3	Adequate encryption algorithms	5	1	Yellow
B	Unsustainable user growth	2	3	Only support LMU users	1	1	Green
C	App designed for multiple platforms	3	5	Computer science capstone students	1	5	Yellow
D	Poor UX/UI Integration	4	3	Internal reviews with experts	2	2	Green
E	Injury liability	4	4	Waivers, exercise review, training	1	2	Green
F	Cyberbullying	3	3	Zero tolerance policy	2	1	Green
G	Pandemic	4	1	Offer at home workouts	3	1	Green

All risks are planned to be effectively managed



# Risk Burndown Cube



# Ethical Considerations

## Four Core Moral Principles [19]:

- **Autonomy**
  - Respect privacy and confidentiality rights
    - Protect all user data
- **Beneficence**
  - Engaging in actions that provide benefits to others
    - Inspire gym attendance to all for health benefits
- **Non-Maleficence**
  - Avoiding actions that would cause harm to others
    - Properly educate and protect users
- **Justice**
  - Equality of access and diversity
    - Maintain fair access to entire LMU undergraduate population



# Agenda

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Acknowledgements

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Purpose

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Verification & Validation Plan

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**Conclusions & Recommendations**

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Further Research

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Learning Outcomes

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# Conclusion and Recommendations

1. LMU Undergraduate students are not attending the gym due to:
  - Time constraints
  - Lack of education
  - Lack of motivation
  
2. Mobile App solution will increase student gym attendance
  - Motivates through incentives and community support
  - Educates through videos, tips, and community support
  
3. Recommend LMU:
  - To put more focus into persuading gym attendance
  - To invest in gym tailored mobile app development





# Further Research

1. App development opportunity for LMU Computer Science Capstone project
2. Roll out trial phase
  - 50 students
  - Assess impacts and results
3. Based on results of trial phase
  - Consider improvements
  - Consider other solutions to address the “too busy” factor
    - Change of school policy
    - Change of class schedules
    - Addition of time slots that students register for
4. Go through solutions with the customer to develop requirements
5. Scale up app solution for use at:
  - Other universities
  - Gym-chains (LA Fitness, Planet Fitness, etc.)
  - Clubs





# Learning Outcomes

- Systems engineering methodology is effective, and can be used on any problem of adequate size
  - Inspiration to pursue entrepreneurial ventures and employ the SE methodology
- Frequent reviewer feedback is important for creating a sound package
- Data gathering is difficult
  - Surveying & Research
    - Good quality data
    - Access
    - Rules
- Difficult to please everyone
- Creating and sticking to a schedule





**FINISH**

Questions?



# List of Acronyms

- AOA = Analysis of Alternatives
- ConOps = Concepts of Operations
- LMU = Loyola Marymount University
- MOE = Measures of Effectiveness
- NPAP = National Physical Activity Plan
- PAG = Physical Activity Guidelines
- SE = Systems Engineering
- SYEG = Systems Engineering Course Code
- U = Unweighted Score
- UHC = United Healthcare
- UI = User Interface Design
- UX = User Experience Design
- W = Weighted score ( $WF * U$ )
- WF = Weight Factor



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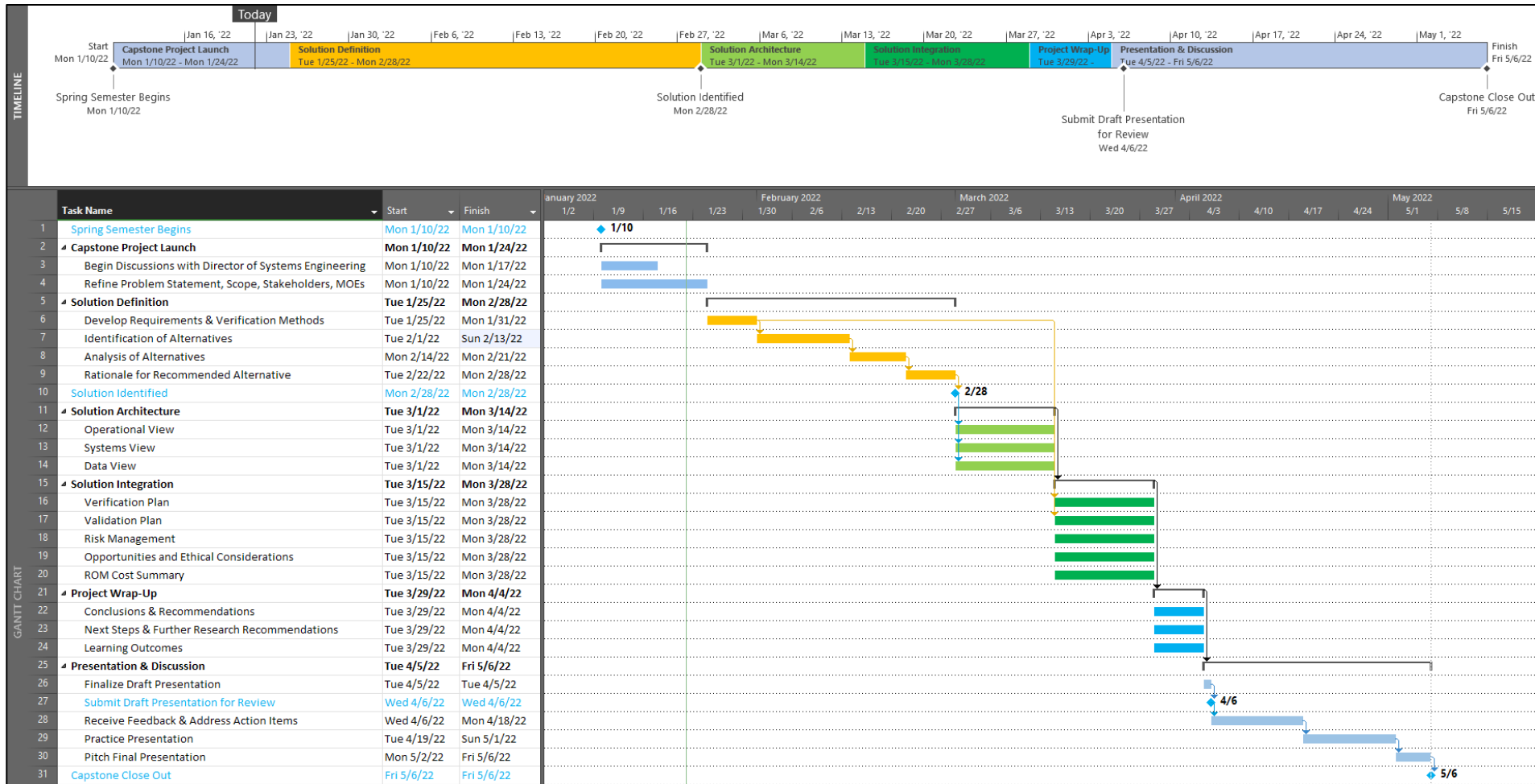
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# Backup

# Project Schedule



Required project steps can be completed on schedule

# Alternate Justifications – Survey Results

- I don't know how the whole recreation center works
- People there can be uncomfortable to be around
- Lack of specific gym equipment
- 6 times a week is adequate for rest
- On the soccer team, so I go when we have off days or done with practices so how often I go depends on my soccer schedule
- I don't like feeling like people are looking at me
- The gym is way too small and too many people are there
- Commuter student, too involved to plan consistent workouts around traffic/homework
- I'm trans and feel unsafe in gendered spaces at the rec center

Less popular justifications exist – hard to address everyone





# Alternative 1 & 2 Research



## **Rebate gym membership fees if attendance threshold is met:**

- 20% increase in gym attendance [13]
  - Major American university
  - Reimbursed \$75 if 50 visits in six month period was met
- Insurance (Aetna, UHC, Affinity)
  - Reimburse up to \$200 to members who attended the gym 50 times in a six month period [13]

## **Lottery based financial incentives as reward:**

- 40% higher probability of freshman male gym attendance [14]
  - Large Midwestern university
  - 1% chance at winning lottery of \$20 with every visit

Financial incentives are effective in increasing gym attendance





# Alternative 3, 4, & 5 Research [16]



- Extrinsic rewards are a positive motivating factor
  - Competition
  - Physical Appearance
  - Social Environment
  - Rewards
- Men respond better to:
  - Competitive gamification of rewards
  - Social Environment
- Women respond better to:
  - Working towards discounts, free smoothies, etc.
  - Social Environment

Physical rewards are less motivational than social environment





# Alternative 6, 7, & 8 Research



## Teach How to Build Workouts

- Personal Trainers
- Exercise Apps

## Teach How to Perform Exercises

- Personal Trainers
- Exercise Apps
- Sports
- Gym Classes
- Videos

## Teach How to Avoid Injury

- Personal Trainers
- Exercise Apps
- Sports
- Gym Classes
- Videos

Mobile apps are considered effective in gym exercise guidance [17]



# Research Plan



## LMU Undergraduate Survey

- Gym use frequency
- Education Sources
- Motivation Sources



## LMU Gym Metrics and Statistics

- Interviews
- Gym Staff
- LMU Gym Director



## Identification of Alternatives

- Journals/Papers
- Books
- Institutional Websites





# Backup Chart

