Massachusetts Institute of Technology

Architecture & Systems Engineering

Week 3: System Architecture

Project Portfolio

Name

Student

Week 3 Project

Overview

In the third project activity of this course, your team will build on a specific project of your own choosing – such as the last system you worked on, or a system from a previous project. Please ensure that the system has at least a medium (but preferably high) level of complexity -- such as a car, satellite, an enterprise server, or an open-source software.

Note that some Scratch Pages are included at the end of the project document for you to capture any ideas, sketches, etc. that you may have as you work through the project. These will not be assessed and you are not required to submit them with your project (but you may do so if you think they offer any additional insight into your thinking process!).

REQUIRED STEPS:

Step 1: Select your system for this project.

Step 2: Produce a solution-neutral function and concept.

Step 3: Develop and analyze a set of architectural decisions.

Step 4: Review and submit your project.

STEP 1: SYSTEM SELECTION

As a group, select a system for your project. Please ensure that (1) at least one team member is knowledgeable about the system, (2) the system has a medium to high level of complexity and (3) group members feel comfortable analyzing the system. Some systems of medium to high complexity include: a car, a satellite, an enterprise server or an open source software such as apache spark.

Please remember the file size limit and resize or paste the image URL instead, as needed.

Name of System: Touring Motorcycle

System Image/Diagram/Schematic View of Form

https://pixabay.com/en/farm-ducati-girl-motorcycle-1264761/ (Royalty Free)

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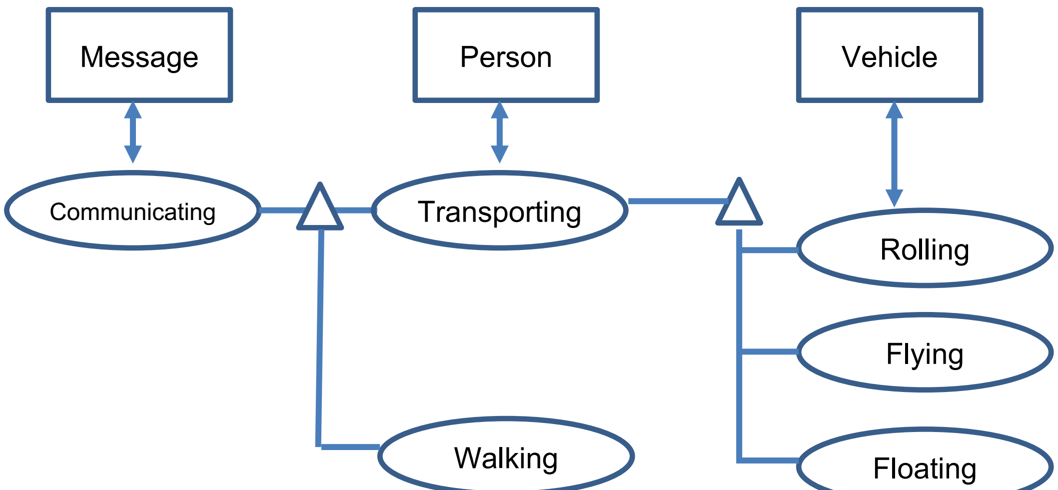
STEP 2A: SOLUTION-NEUTRAL FUNCTIONS

For the system you selected, provide a possible hierarchy of the solution neutral to solution specific functions. The focus of this diagram is processes. For your system illustrate a range of processes from more solution neutral (like "accessing") to more solution specific (like "pushing"). It may be helpful to refer to the Wine Bottle System example in the video and to the sample project. You may also illustrate the operand (s) on this diagram (e.g. cork, bottle, wine), but do not illustrate the forms associated with each process.
Please remember the file size limit and resize or paste the image URL instead, as needed



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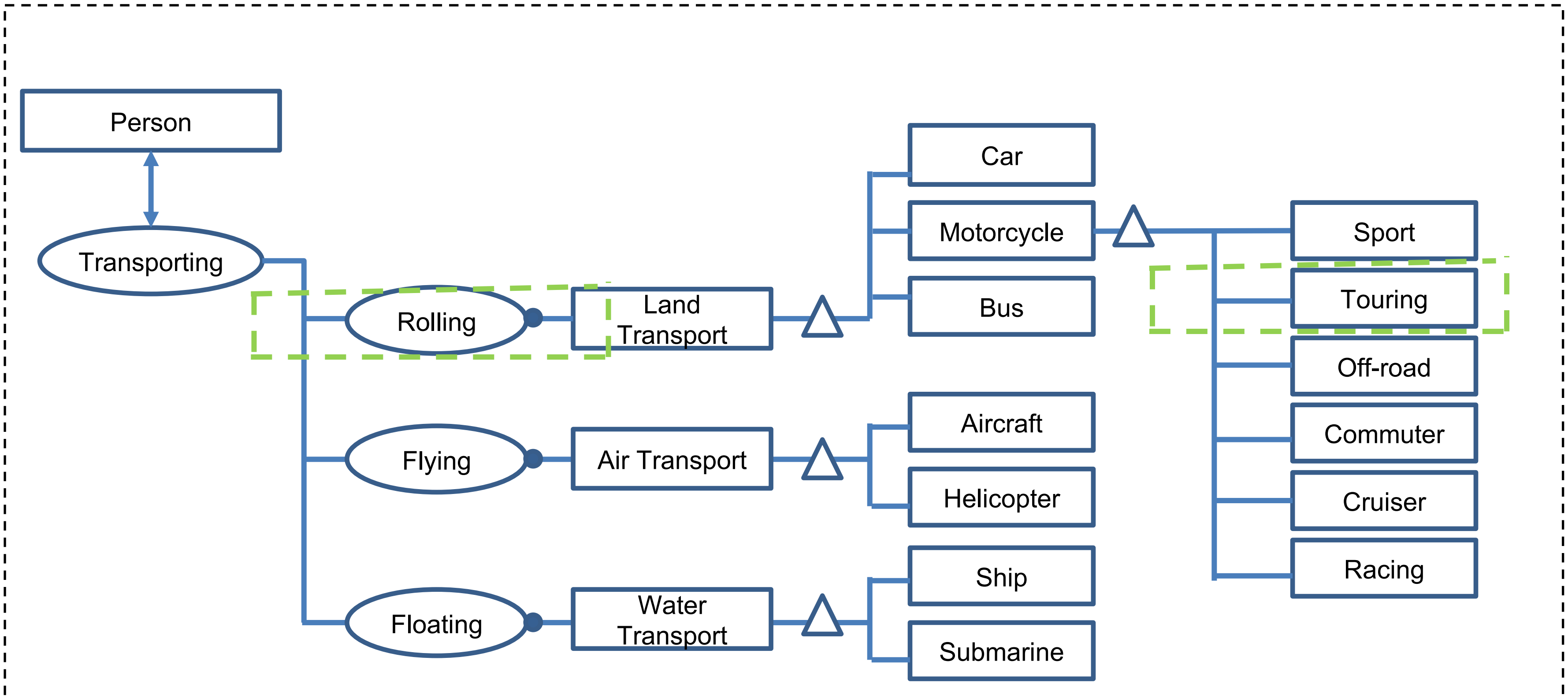
STEP 2B: FORMS

For the solution-neutral functions produced in step 2A, develop a set of possible forms that could be used. For example, in the Wine Bottle Example if you chose "Cork Removing", now illustrate several forms by which you could accomplish this – Cork Suctioning Using a Vacuum Device, Cork Pulling Using a Corkscrew, etc. Mark your selected concept by drawing a system boundary around the selected function and form.

Please remember the file size limit and resize or paste the image URL instead, as needed.



STEP 3A: ARCHITECTURAL DECISIONS

For your system develop a set of architectural decisions (minimum of 5) keeping in mind that such decisions must be highly connected and/or sensitive to the key stakeholder metrics. Provide a rationale for the decision and one to two options/alternatives.

Architectural decision	Rationale	Option(s)
1000 cc twin cylinder engine	Heavy touring bikes require adequate engine power and torque	Single Cylinder Engine, 4 Cylinder Engine
Full body fairing	Aerodynamic form increases fuel efficiency for long tours	Half fairing, No fairing
Multi-function integrated LCD digital display	Multiple types of information shown on single display	Analog Instruments
20 liter fuel tank	Greater touring range, fewer fuel stops.	Battery electric, 10 liter tank
Chain drive	Easier access for maintenance and replacement while on tour	Shaft drive, Belt drive
Twin heated seats	Comfort for rider and passenger on long tours	Single seat, Detachable passenger seat
Slipper clutch	Mitigates engine braking effects, better cornering	Dry clutch
Anti-lock braking system	Improved safety, better braking performance	Conventional disc brakes, Drum brakes
Rear monoshock suspension	Smoother ride, better comfort and greater stability	Dual rear shock

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STEP 3B: ARCHITECTURAL DECISIONS

For the set of architectural decisions developed in the step 3A, classify them by highly coupled/sensitive decisions in the matrix given below. We want you to actively classify these decisions, not automatically place all of them in the High Sensitivity / Highly Coupled box.

	Low Sensitivity	**High Sensitivity**
Highly coupled	Full body fairing Chain drive Slipper clutch	1000 cc twin cylinder engine Multi-function integrated LCD digital display Rear monoshock suspension
Loosely coupled	Twin heated seats	20 liter fuel tank Anti-lock braking system

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STEP 3C: ARCHITECTURAL DECISIONS

For the set of architectural decisions developed, include a small write-up with constructive feedback that touches on the following. Do these decisions represent the architecture of the system? Are they true architectural decisions?

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Decisions relating to the engine type and capacity, the rear suspension, and LCD display are architectural decisions that are highly coupled and sensitive. A V-twin engine and an in-line engine will require significant differences in the design of the crank shaft and case, the chassis, and exhaust system, hence they are highly coupled. The engine also affects the ride characteristics (speed, handling, stability etc), fuel efficiency, noise and vibration, which are all metrics of interest for a touring bike, hence it is a sensitive decision. Ride characteristics are also sensitive to the choice of a mono-shock and dual shock rear suspension, while such a choice also dictates significant differences in the design of the chassis and rear swing arm. The LCD display, in contrast to analog instruments, is highly connected since all sorts of information can now be displayed (trip, range, efficiency etc).

Decisions regarding fuel tank size and anti-lock braking are highly sensitive – these directly impact the range and safety of a touring motorcycle. However, these are also decisions that can be taken a bit further down the design process without incurring serious design changes, implying a lower level of connectedness.

Decisions regarding the body fairing, chain drive and clutch type are highly coupled – changing over to a different fairing type, or shaft drive or a dry clutch will incur significant design changes. However, these are all architectural alternatives that can provide similar levels of performance, and exhibit low sensitivity towards metrics of interest.

The seat design is not a true architectural decision, since it is not highly coupled and can be changed relatively easily later in the design process.