Architecture & Systems Engineering

Week 4: Modeling with DSMs and Modularization

Project Portfolio

Name

Student

Week 4 Project

Overview

In the fourth project activity of this course, you will continue to build on the system your team selected during Week 3. We will further study the system by decomposing it and reviewing its change propagation properties. The steps on the right will guide you through this process.

Note that some Scratch Pages are included at the end of this document for you to capture any ideas, sketches, etc. you 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: Decompose the system.

Step 2: Analyze the system DSM.

Step 3: Identify the change propagation.

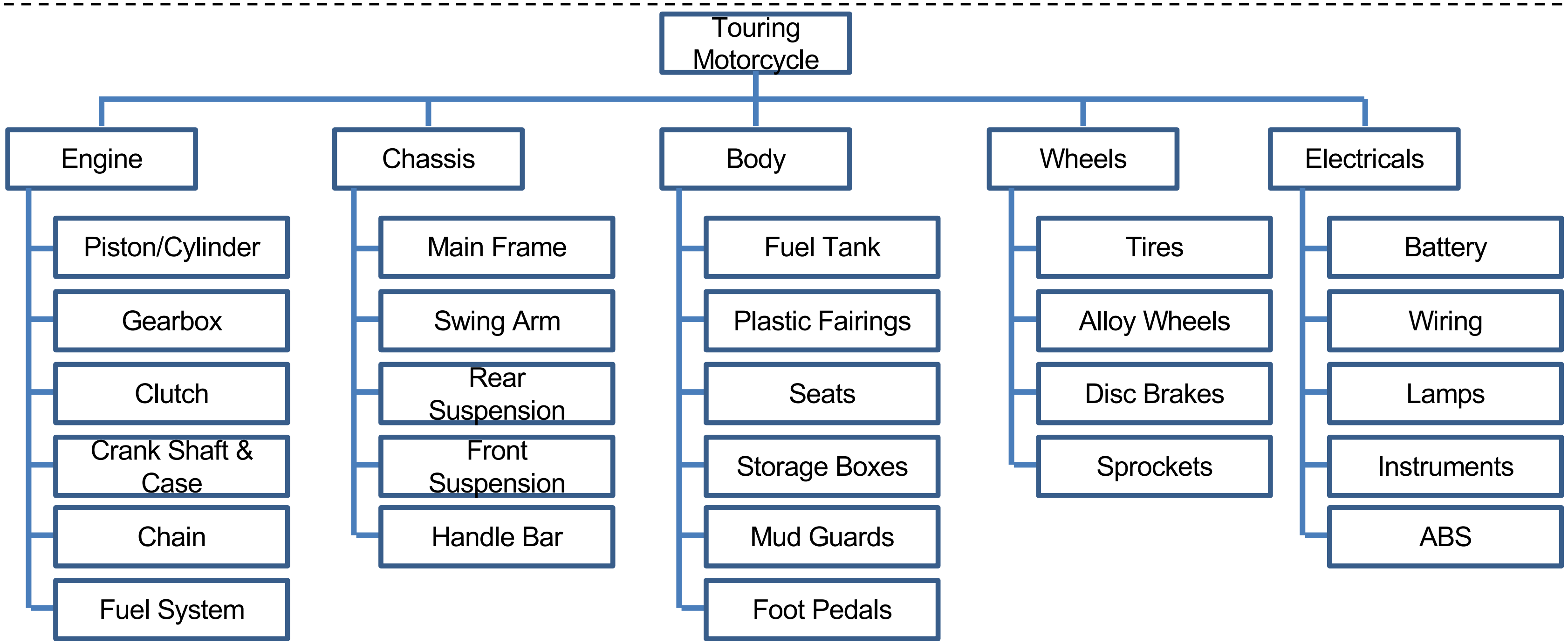
Step 4: Review and submit your project.

STEP 1: DECOMPOSE THE SYSTEM

For your system chosen in Week 3, develop a system decomposition. The system decomposition should be (1) of form (objects), (2) a two-level down decomposition with 7±2 components per level and (3) shown as a tree structure or an indented list.
Please remember the file size limit and __resize__ or paste the image URL instead, as needed.

Name of System: Touring Motorcycle

System Decomposition:



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STEP 2A: SYSTEM DSM

Based on your Level Two system decomposition from Step 1, develop a N x N Design Structure Matrix. Clearly label each row and column. Attempt to arrange objects in the order of decomposition. This will allow you to match Level One modules in the DSM.

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

System DSM

Sort Box Dash

key			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
1	Piston/Cylinder	A	A			X		X																					A
2	Gearbox	B		B	X	X																							B
3	Clutch	C		X	C	X	X						X																C
4	Crank Shaft & Case	D	X	X	X	D	X	X	X										X						X				D
5	Chain	E			X	X	E			X													X						E
6	Fuel System	F	X			X		F					X	X													X		F
7	Main Frame	G				X			G	X	X	X	X	X	X	X	X							X	X	X	X		G
8	Swing Arm	H					X		X	H	X								X		X	X						X	H
9	Rear Suspension	I							X	X	I						X				X								I
10	Front Suspension	J							X			J	x					X			X	X						X	J
11	Handle Bar	K			X			X	X			x	K									X			X	X	X	X	K
12	Fuel Tank	L						X	X					L	X	X									X		X		L
13	Plastic Fairings	M							X					X	M	X	X	X							X	X			M
14	Seats	N							X					X	X	N	X												N
15	Storage Boxes	O							X		X				X	X	O												O
16	Mud Guards	P										X			X			P		X									P
17	Foot Pedals	Q				X				X									Q			X							Q
18	Tires	R																X		R	X	X							R
19	Alloy Wheels	S								X	X	X								X	S	X	X						S
20	Disc Brakes	T								X		X	X						X	X	X	T			X	X		X	T
21	Sprockets	U					X														X		U						U
22	Battery	V							X															V	X	X	X	X	V
23	Wiring	W				X			X				X	X	X							X		X	W	X	X	X	W
24	Lamps	X							X				X		X							X		X	X	X	X		X
25	Instruments	Y						X	X				X	X										X	X	X	Y	X	Y
26	ABS	Z								X		X	X									X		X	X		X	Z	Z
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	

STEP 2B: SYSTEM DSM

Given the DSM developed in the previous step, attempt to cluster or partition one level up in order to expose modules of the system. Are the modules identical or different than your form decomposition from Step 1? What insights can you gain as an architect from a DSM? Please use the DSM Excel file provided in this module.
Please remember the file size limit and <u>resize</u> or paste the image URL instead, as needed.

System clustering:

Sort

Box

Dash

key			D	B	C	A	F	G	E	H	L	I	J	M	N	Q	O	P	S	R	U	V	Y	W	Z	X	T	K	
1	Crank Shaft & Case	D	D	X	X	X	X	X	X							X								X					D
2	Gearbox	B	X	B	X																								B
3	Clutch	C	X	X	C				X																			X	C
4	Piston/Cylinder	A	X			A	X																						A
6	Fuel System	F	X			X	F				X												X					X	F
7	Main Frame	G	X					G		X	X	X	X	X	X		X					X	X	X		X		X	G
8	Chain	E	X		X				E	X											X								E
8	Swing Arm	H						X	X	H		X				X			X						X		X		H
8	Fuel Tank	L					X	X			L			X	X								X	X					L
9	Rear Suspension	I						X		X		I					X		X										I
10	Front Suspension	J						X					J					X	X						X		X	x	J
13	Plastic Fairings	M						X			X			M	X		X	X						X		X			M
14	Seats	N						X			X			X	N		X												N
14	Foot Pedals	Q	X							X						Q											X		Q
15	Storage Boxes	O						X				X		X	X		O												O
16	Mud Guards	P											X	X				P		X									P
17	Alloy Wheels	S								X		X	X						S	X	X						X		S
18	Tires	R																X	X	R							X		R
21	Sprockets	U							X										X		U								U
22	Battery	V						X														V	X	X	X	X			V
25	Instruments	Y					X	X			X											X	Y	X	X	X		X	Y
26	Wiring	W	X					X			X			X								X	X	W	X	X	X	X	W
26	ABS	Z								X			X									X	X	X	Z		X	X	Z
27	Lamps	X						X						X								X	X	X		X	X	X	X
28	Disc Brakes	T								X			X			X			X	X				X	X	X	T	X	T
29	Handle Bar	K			X		X	X					x										X	X	X	X	X	K	K
			D	B	C	A	F	G	E	H	L	I	J	M	N	Q	O	P	S	R	U	V	Y	W	Z	X	T	K	

Insights from 2 down 1 up DSM partitioning

- Four clusters emerge after partitioning the DSM, instead of the five that were started with.
- The second block, which is the largest, contains elements of body and chassis (from original decomp.) which indicate a high degree of coupling between them.
- Modules such as ABS, wiring, and instruments interface with a lot of other systems, and do not fit neatly into the new clusters. (yellow shading)

STEP 3: CHANGE PROPAGATION

Given the DSM developed in Step 2A, identify a sorted list of Level Two objects (top five) which would create a large change propagation impact. In essence, what are the top components which would represent the largest change propagation chains in the system? List the components and identify up to three of the longest chains of propagation among the components.

Change propagating components:

Component description	Number of Interfaces of the component	Change chain propagation [c1-c2-cX], [c1-c4-cX]
Main Frame	12	Changing the main frame geometry results in changes to the crank shaft and case to which it is highly coupled, which in turn causes changes to clutch and gearbox
Handle Bar	9	Changing handle bar type (clip-ons vs regular for e.g.) changes instrument placement, but the change may not propagate further
Crank Shaft & Case	8	Changing the crank shaft and case size affects the size of the piston/cylinder combination, as well as the size of the clutch and gearbox, which in turn affects wheel size
Disc Brakes	8	Changing disc brake geometry affects wheel size, which in turn may affect gear ratios and hence gearbox
Wiring	6	Changes in wiring geometry may affect attachment points on the main frame (or other interfaces) but are unlikely to propagate further.