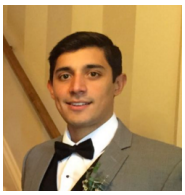
Industrial, Manufacturing, & Systems Engineering
College of Engineering

Systems Engineering Project Practicum
Summary

Project Title:	Vehicle Health Report Simulator
Team members:	Jose Cervantes
Semester, year:	Spring 2016
Type of project:	Individual project at students work ( ) Team project assigned by instructor ( ) Project proposed by team (X)



Jose Cervantes

INTRODUCTION

The System Engineering Project Practicum provides the opportunity to apply System Engineering concepts in developing a real system and create documents that formally describe the system. Students review documents and validate them with clients and customers through formal presentations. Teams are self-managed and assign roles to control planning, quality, requirements, design, and implementation.

System Overview

Ford has come with the project of designing a simulator for the Vehicle Health Report (VHR) system to represent eight integrated systems in order to have capability to activate them on vehicle's diagnostic tool and simultaneously on the cluster to test the VHR system.

Ford has asked for this software simulator to recreate different scenarios where the car through a system diagnostic protocol can detect failures and report them to the owner. The simulator is intended for the Vehicle Health Report System, which is currently on the market.
It is well known that as every car, Ford Vehicles have the capability to display some potential malfunctions on the cluster by lighting some icons when a system is potentially failing, for instance: Check Engine Light, Oil Level, etc.
The car's owner has an In-vehicle tool to run a Vehicle Health Report on the car to identify how big is the problem and how much time is left to take the car to the dealership or car shop for maintenance or to fix

it.

In order to test the several systems and thus the lights that appear on the cluster when one of the system fails, Ford has hired P3 NA to develop a tool/ software (Simulator) to reproduce the eight possible failures without the need of having all the systems physically connected to the car.

The challenge begins when nowadays they need to have the systems physically all connected to simulate a malfunction and with the software simulator to be developed the malfunction could be generated without having the actual component/system connected to the system.

The problems are that the current testing and validation process requires them to interact physically with the systems to be simulated and this uses more time than a simulator would need, second, the potential harm that the mechanicals can suffer by manipulating the physical components and third, that the connections and environments created by the mechanicals can vary a little bit from one time to the another even though the process is standardized and this variations on the setup might alter the validation results.

By developing this software eight systems will be simulated saving money and time as mentioned, the stated problem can be solved 100% by simulating the eight systems under scope.

The VHR Simulator tool will be able to discard the need of the hard physical interaction of the technicians and mechanicals by using the software to emulate the required systems on the cluster and thus recreate the needed scenarios to test the VHR application.

System Description

The Vehicle Health Report (VHR) Simulator provides the means by which to develop an interactive VHR simulation environment (with provided hardware) that allows for the activation of cluster-specific Diagnostic Trouble Codes (DTC's) and Telltales to be collected and transmitted to FORD's web-based application (SyncMyRide.com). Additionally this application also includes general information regarding the initial setup, diagnostic control, and operation of the FORD VHR System.

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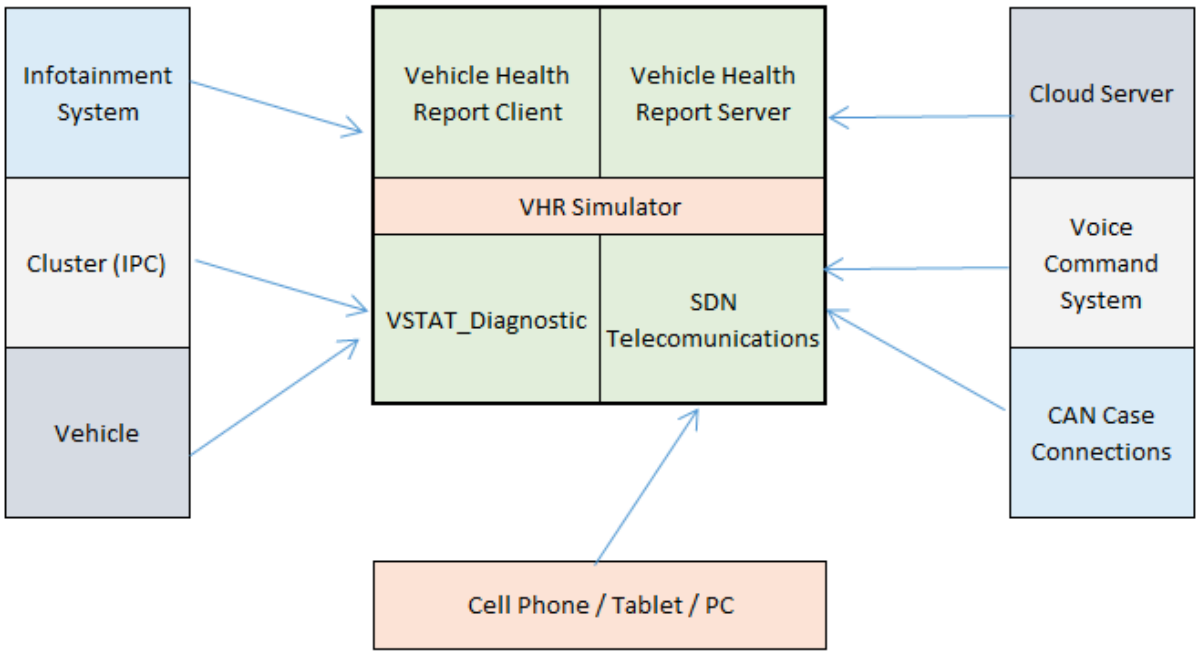

Figure 1. External entities with system components

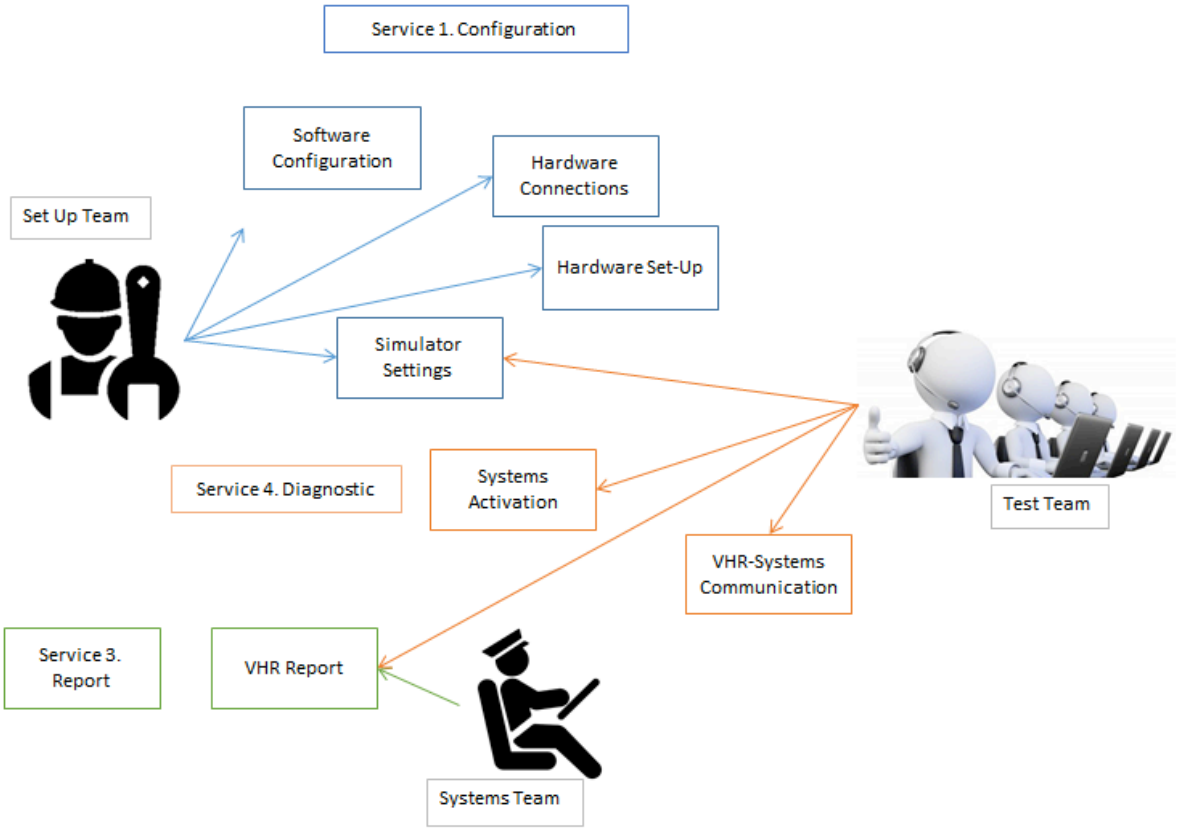

Figure 2. Use case diagram

Life Cycle:

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Task	Duration (Days)	From	To	Jan				Feb				Mar				Apr				May			
				W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
Problem Description	5	20-Jan	25-Jan																				
Project Description	10	25-Jan	4-Feb																				
System Content	15	4-Feb	19-Feb																				
Concept Of Operations	15	19-Feb	5-Mar																				
System Requirements	10	5-Mar	15-Mar																				
Project Management	15	15-Mar	30-Mar																				
System Design	15	30-Mar	14-Apr																				
IVV Plan	12	14-Apr	26-Apr																				
System Implementation	12	26-Apr	8-May																				
Final Report	10	8-May	18-May																				
Executive Presentation	10	18-May	28-May																				
Total	129																						

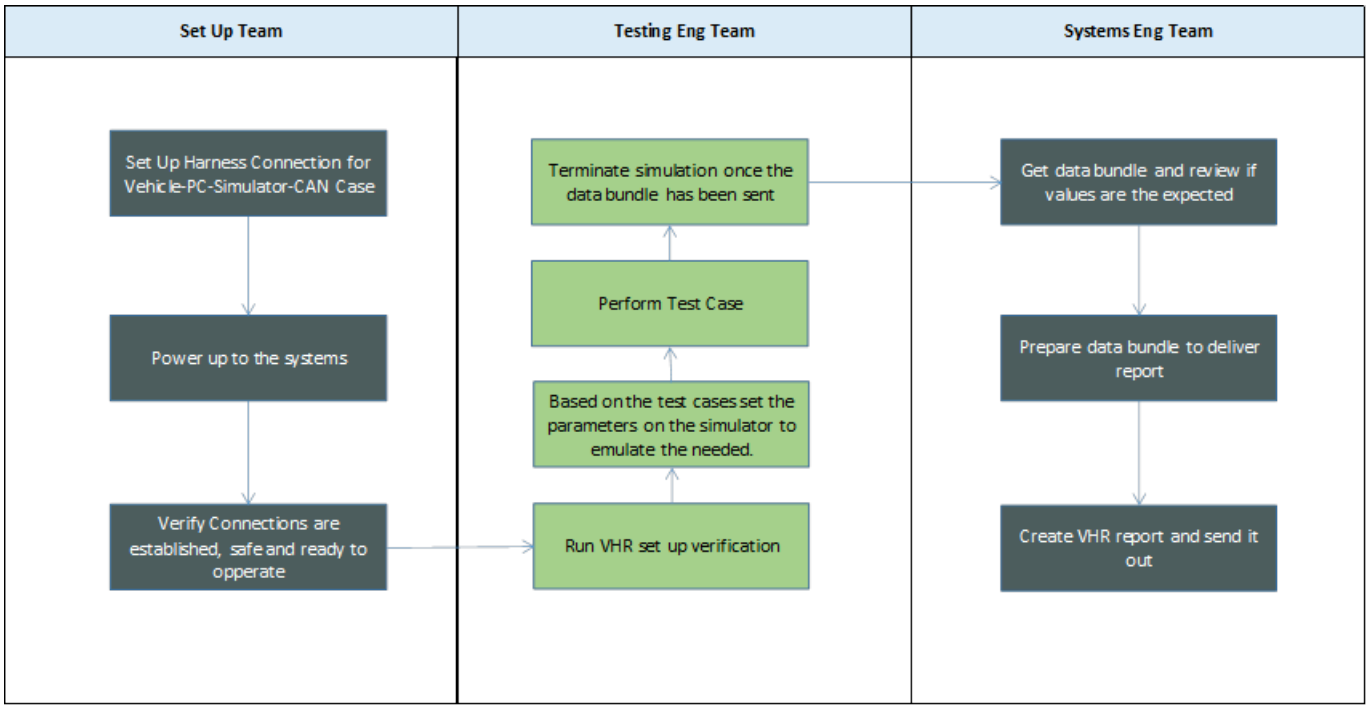

Diagram 1. Activity diagram

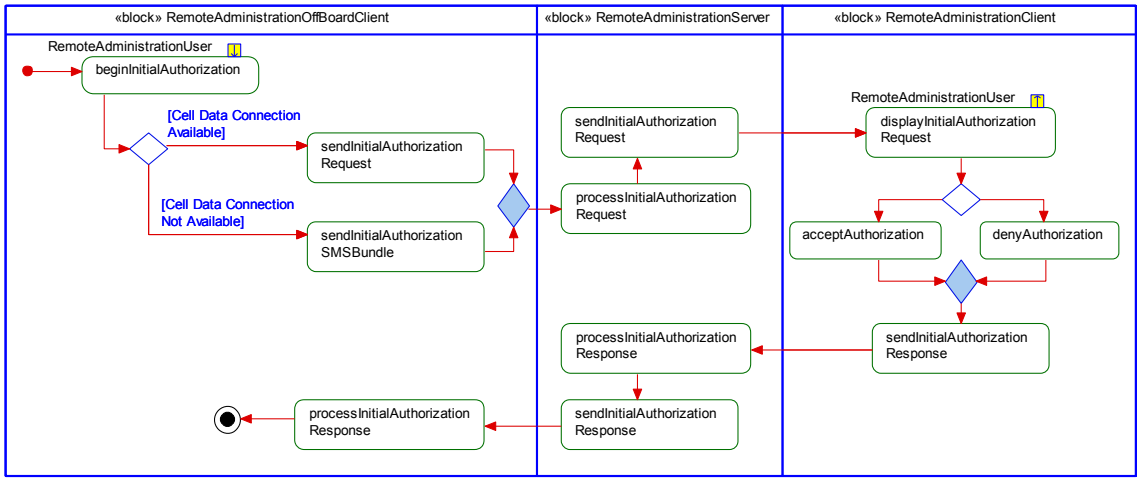

Figure 3. Internal Block Diagram for the Initial Authorization Process

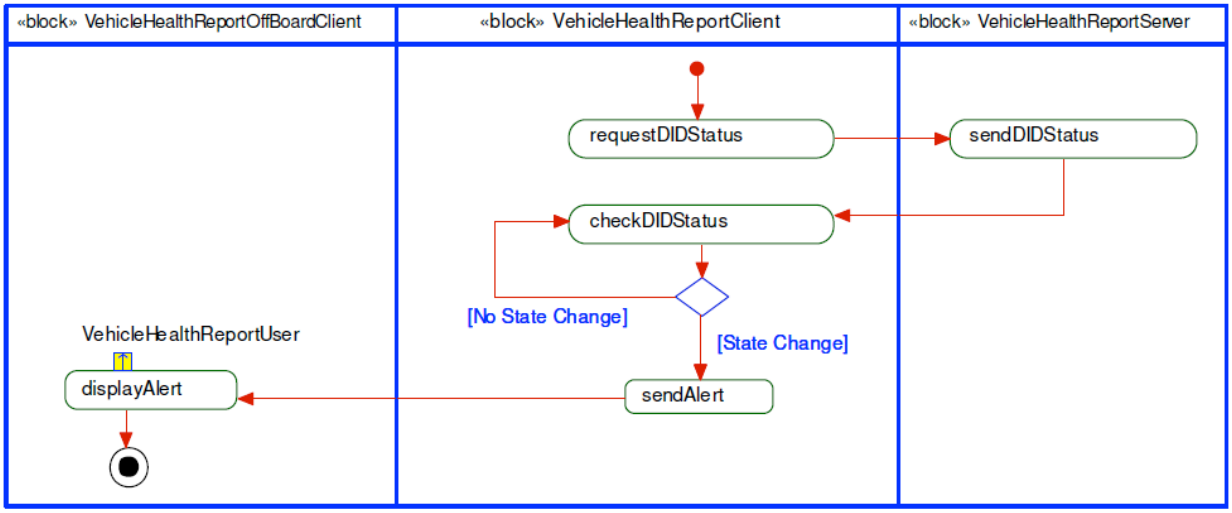

Figure 4. TCU detects Vehicle Health Alert

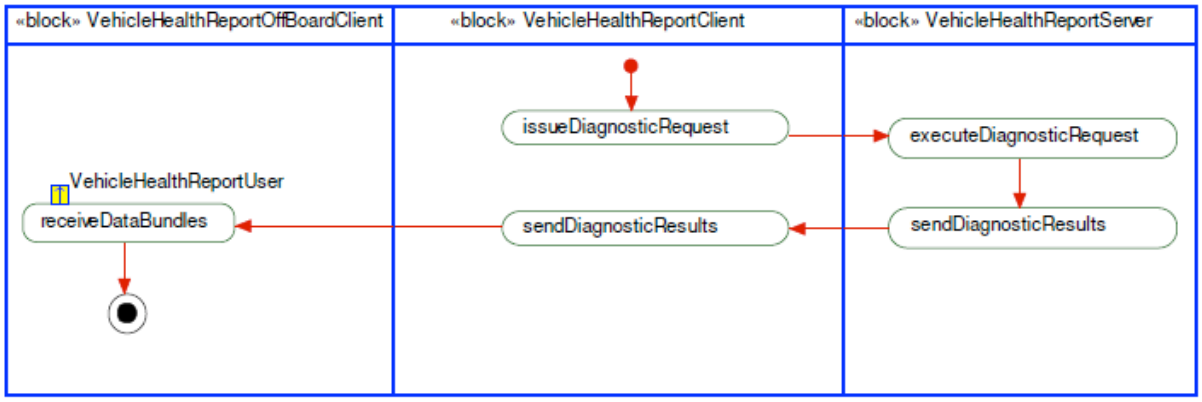

Figure 5. TCU performs request for DTCs

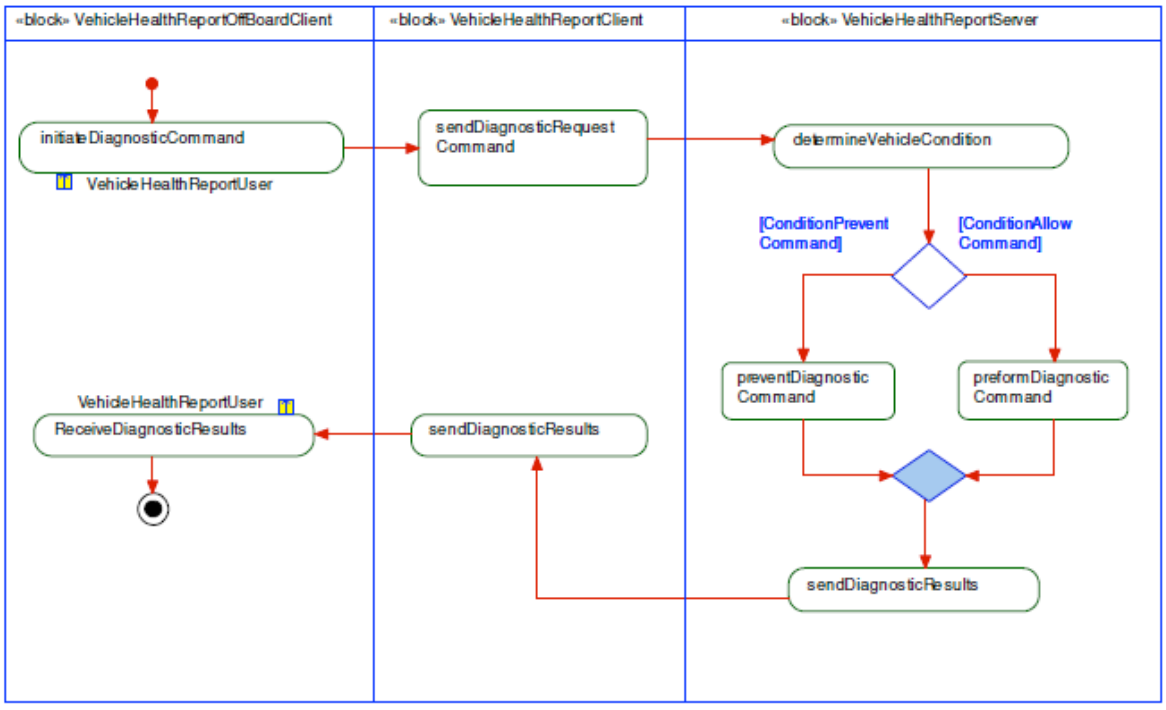

Figure 6. Perform Diagnostic Command issued by Web Service

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PROJECT OUTCOMES

As mentioned this project has been developed for Ford North America, for the Telematics Department which is in charge of the design and development of the Vehicle Health Report application, from a Telematics perspective this project adds a lot of value to the testing and validation for several reasons: Less human resources needed, less physical harm to testers, less time to test and validate the VHR application and a more consistent test procedure is applied.

Project Quality Details:

		Conceptual Phase	Conceptual Review	System Requirements Phase	System Requirements Review	SEM Plan Phase	SEM Plan Review	Prototype Phase	Prototype Review	Design Phase	Design Review	Implementation Phase	Implementation Review	Unit Testing Phase	Integration Testing Phase	System Testing Phase	Total Lifecycle
A	Time (hr)	19	17	10	10	5	7	8	5	13	7	20	10	18	13	13	175
B	Time (%)	10.9%	9.7%	5.7%	5.7%	2.9%	4.0%	4.6%	2.9%	7.4%	4.0%	11.4%	5.7%	10.3%	7.4%	7.4%	100%
C	# Defect Injected	58		19		11		10		23		55					176
D	% Defect Injected	32.9%		10.8%		6.2%		5.7%		13.1%		31.3%					100%
E	Injection Rate (defect/hr)	3.1		1.9		2.2		1.3		1.8		2.8					
F	# Defects Removed		54		20		13		8		26		52	1	1	1	176
G	% Defect Removed		30.7%		11.4%		7.4%		4.5%		14.8%		29.5%	0.6%	0.6%	0.6%	100%
H	Removal Rate (defect/hr)		3.2		2.0		1.9		1.6		3.7		5.2	0.1	0.1	0.1	
I	Defect Removal Leverage (DRL)		57.2		36.0		33.4		28.8		66.9		93.6				
J	Yield (%)		93.1%		87.0%		92.9%		72.7%		100.0%		94.2%	31.3%	45.5%	83.3%	
K	Step Size	12		112		12		14		33		3		1	1	1	209
L	Defect Density		4.50		0.18		1.08		0.57		0.49		17.33	1.00	1.00	1.00	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	

Defect Injection Phase
Defect Removal Phase
Input Data

% Cost of Assesment	32%
% Cost of Failure	25%
Cost of Quality	1.27

Figure 7. Project Quality Dashboard

The quality of this project is medium because our Cost of Quality is 1.27 on a scale from 0-2 where 0 is poor quality and 2 is excellent quality. It could possible mean that more time should be spent in the review phases to ensure an increase in quality.

The overall quality for the VHR simulator is appreciated as high, with the numbers shown on the tables above it can be confirmed, that a robust design plan and execution was performed.

By the numbers gotten could be tell that the Design review phase is the strongest one, on the other hand the prototype phase might be a little bit weaker, although the both rates are acceptable, and for the prototype phase there is room for improvement, which will be part of the future actions.

This analysis helped to realize how important the quality is regarding projects development, it helped to identify the weak spots and bring more and newer tools, resources and ideas to improve the current status and move it to the next level.

The main soft skill I take from developing this project is: Adaptability. It is not easy to adapt to change, the mindset has to change not in one but in the whole crew, technology is evolving and has captured the new generations but for the old management sometimes is hard to understand the value of improving the

Validation, Verification and Testing process, so to create this adaption from the old way to the new one is always a challenge but one that brought so many good results at the end

The most important concept for me was the Systems Requirements, to think and write all the requirements in such a way that they can be understandable and translated into an actual service/product is always a challenge, but with this course and the guidelines provided made it much easier.

Nonetheless is important to point that this project was extracted from my professional work and it helped so much to do it for Ford at the same time that for UTEP, the project would never had all the documents and structure that I took thanks to the lectures and direction provided in the Practicum Course.

MASTERS OF SCIENCE IN SYSTEM ENGINEERING PROGRAM ASSESSMENT

The Systems Engineering program at UTEP provided me in-depth knowledge and technical skills in the field of systems engineering and systems of systems, and prepared me as student to become a professional for careers within industry (aerospace or automotive) and government (Defense Department). This systems-centric program addressed the needs of engineers and scientists engaged in all aspects of analysis, design, integration, production, and operation of modern systems.

The systems engineering process helped me to coordinate and led the translation of an operational need into a system designed to meet that need. It integrated the inputs of all the required technical disciplines into a coordinated effort that meets established performance, cost, and schedule goals. Us as systems engineers provided the leadership and coordination of the planning, development, and engineering of technical systems, including hardware and software components in the several projects that we developed along this Systems Engineering Study Program.

Among the opportunities that I had during this time, it is the Ford project that I developed, and which I consider the most important so far, since it really was applied and translated to real life. The upper sections talk about it, and the process of developing this project for the Practicum class added so much value to me and my experience.

Things that I learned and will recommend to anyone who is interested in this masters are the following three:

- Evaluation of complex systems and systems of systems, ability to conceive of, gather user needs

and requirements, design, develop, integrate, and test complex systems by employing systems engineering thinking and processes, within required operational and acquisition system environments.

- Understand and utilize the life cycle stages of systems development from concept development through manufacturing and operational maintenance.
- Exercise their responsibilities in the management of cost-effective systems product development by leading and participating in interdisciplinary teams.

If these three topics are of your interest, Systems Engineering is the right Masters for you, don't doubt it!