

# A LIFE CYCLE COST ANALYSIS APPROACH FOR EMERGING INTELLIGENT TRANSPORTATION SYSTEMS WITH CONNECTED AND AUTONOMOUS VEHICLES

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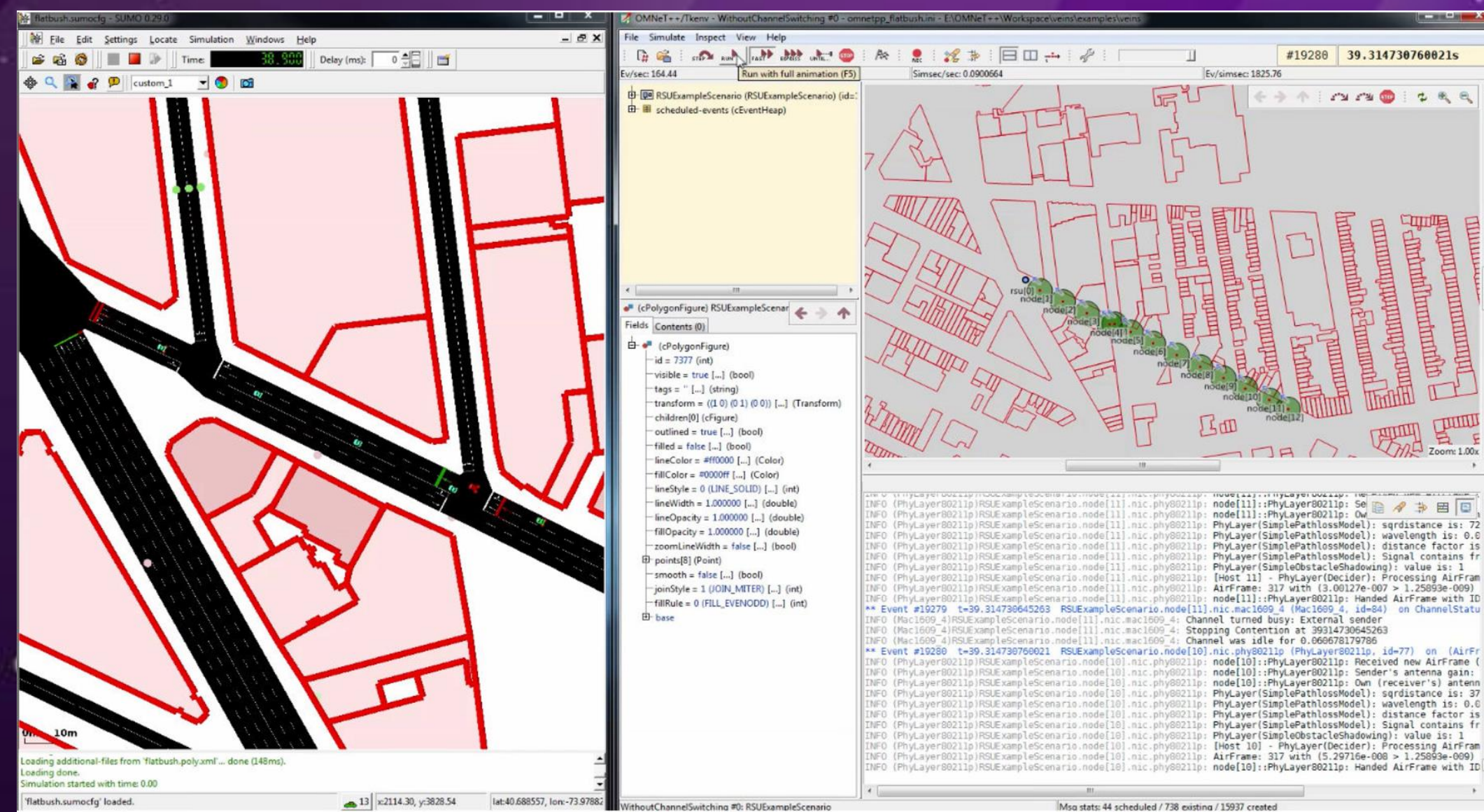
## LIFE CYCLE COST ANALYSIS

## New Framework for ITS

The objective of this paper is to describe five fundamental differences arising from the application of Life Cycle Cost Analysis (LCCA) to a technology-oriented Intelligent Transportation System (ITS) project rather than a conventional transportation project.

A conceptual LCCA framework is proposed for technology-oriented emerging Intelligent Transportation Systems based on **connected and autonomous vehicles**

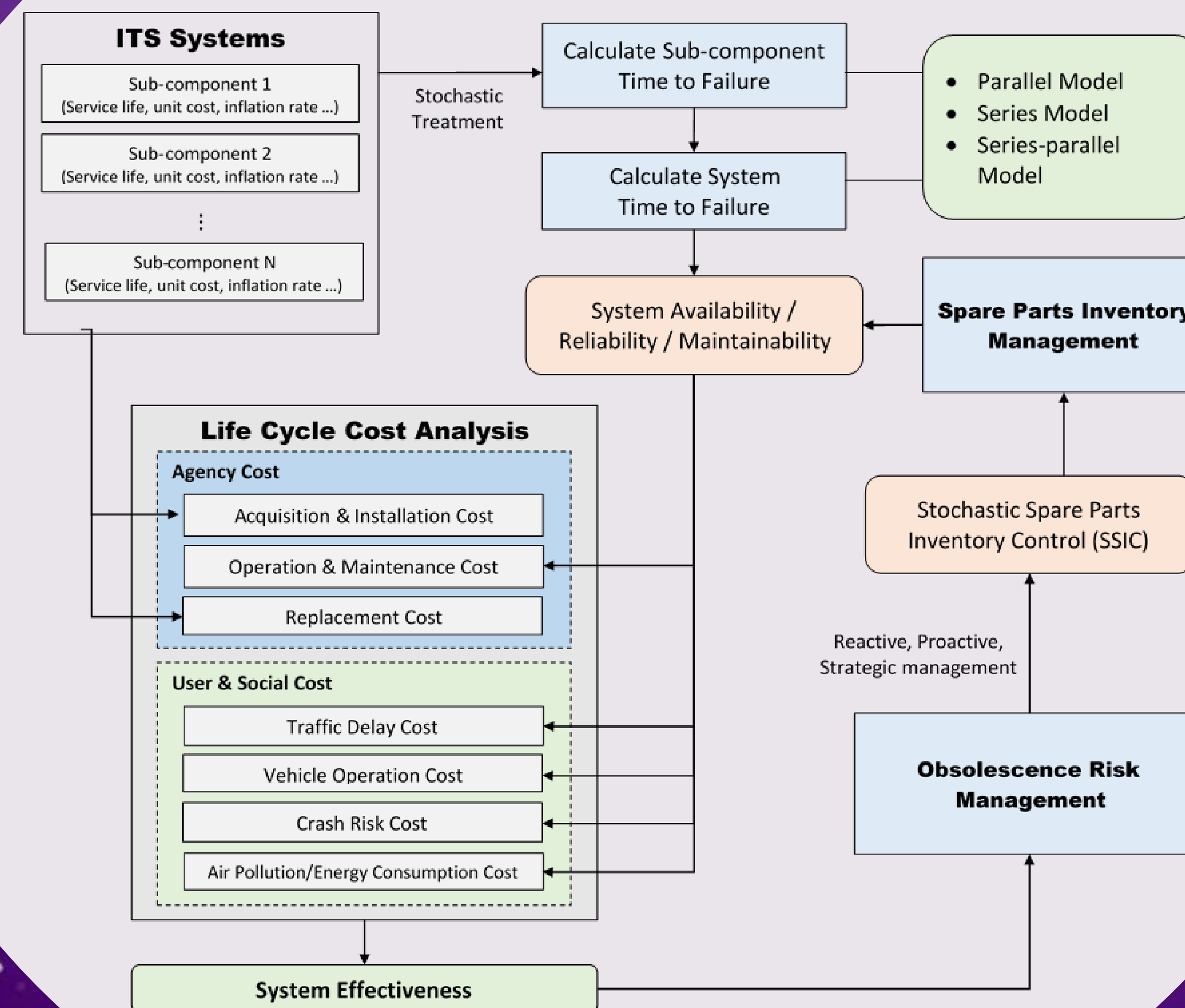
## SUMO – User Cost



A viable alternative to quantify user cost is introduced by utilizing outputs from traffic simulations based on traffic delay, vehicle operation and crash risk cost models. Hypothetical failure rate scenarios were developed through the use of an open-source micro-simulation traffic software namely, SUMO, in a connected vehicle environment.

- Scenario O1-1, O1-2, O1-3: OBU are not functional on 10%, 20%, and 30% of the vehicles
- Scenario R1-1, R1-2: All RSU are not functional at 10% and 20% of the time

Percentage change compare with base scenario	O1-1	O1-2	O1-3	R1-1	R1-2
	OBU 10%	OBU 20%	OBU 30%	RSU 10%	RSU 20%
Traffic Delay Cost	17.3%	70.8%	430.6%	71.0%	279.6%
Vehicle Operation Cost	13.1%	69.3%	370.0%	82.3%	275.7%
Crash Risk Cost	-0.3%	-6.5%	-2.5%	7.6%	30.2%



## Five Fundamental Differences

- Different inflation behavior
- Higher uncertainty
- Out-of-pocket costs
- Technical obsolescence
- Inventory management

ITS Systems based on CAV vs Conventional Transportation system

## Investigation on Inflation Rate

A closer investigation of the inflation rate at the macro-level reveals that inflation rate of ITS components does not follow the general upward trend of CPI, PPI and NHCCI.

Year	Wireless telecommunication	Electronic components	Electronic computers and equipment	Installation, maintenance, and repair occupations	Technical occupations	Other nonresidential construction
2010	96.4	73.5	35.8	112	117.4	100.7
2011	93.0	71.0	34	115.3	119.9	108.6
2012	90.7	69.3	32.8	118	122.3	110.5
2013	89.8	69.0	31	120.1	124.2	110
2014	87.1	68.6	30.3	123.9	126.5	110.7
2015	79.4	68.2	29.1	125.2	128.5	N/A
2016	73.3	67.2	27.9	127.3	130.5	N/A
Avg. Annual Change	-4.4%	-2.3%	-6.8%	2.2%	1.8%	2.4%