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Comparison of Selection Methods of Genetic Algorithms for Automated Component-Selection of Design Synthesis with Model-Based Systems Engineering

Ho Kit Robert Ong¹ and Thotsapon Sortrakul²

¹Graduate Student, Vincent Mary School of Science and Technology, Master of Science in Information Technology, Assumption University, 592/3 Soi 24 Ramkhamhaeng Road, Hua Mak, Bangkok, 10240, Thailand, Robert_ong@me.com

²Lecturer, Vincent Mary School of Science and Technology, Master of Science in Information Technology, Assumption University, 592/3 Soi 24 Ramkhamhaeng Road, Hua Mak, Bangkok, 10240, Thailand, thotsapon@scitech.au.edu

Abstract

One of the important tasks of design synthesis with the Model-Based Systems Engineering (MBSE) is the component-selection. A trade study analysis is commonly used to perform this task, but when it is used for a complex system such as a hybrid car, the analysis will be error-prone, time and cost-consuming. A Genetic Algorithm (GA) is an evolutionary searching technique that can be optimized and used to solve the selection problems. This paper compares between the GA's Elitism and the Roulette-Wheel selection methods when performing a trade study analysis for physical components-selection based on the Systems Modeling Language (SysML) logical architecture model of a hybrid car consisting of an engine, an electric motor, and a battery; and selects the optimum method for automating the MBSE-based trade study analysis. The results indicate that the Elitism selector has a better comparative performance than the Roulette-Wheel selector.

Keywords: Model-Based System Engineering (MBSE), Systems Modeling Language (SysML), Genetic Algorithms (GA), Evolutionary Algorithms, Elitism, Roulette-Wheel, trade study, design synthesis.

1. Introduction

Systems complexity today has increased dramatically. The complexity is driven by the number of components including software and the dependencies between those components. The Model-Based Systems Engineering (MBSE) has a promising approach to manage system complexity. The Systems Modeling Language or SysML [1] was developed to facilitate MBSE. SysML provides systems engineers with a high-level abstraction and visual representation of 4 main design concerns, requirements, system structure and behavior, and parameters. In MBSE, design synthesis is a process that includes the generation of physical architecture specifications that satisfy the logical design and desired functional specifications [2].

Trade study is one of the tasks in design synthesis that can help the system engineers select the right design and components. The system engineers usually need to design several possible alternative architectures of a system and manually analyze them to find the best design. However, with today's system complexity such as autonomous vehicle and its increasing number of components, their dependency and integration, the traditional method may be insufficient because searching through many possibilities based on the specific requirements is often time and cost consuming [3] and error-prone [4]. Therefore, optimizing the searching method is necessary to overcome this problem [3].

The Genetic Algorithms (GAs) [5] have been applied successfully to solve many engineering problems, e.g. electromagnetic system design, aircraft control system and its aerodynamics [6] [7]. Some research studies have shown the potentials of using GAs in system engineering and thus some scholars think that GAs and design synthesis can complement each other [8]. In his book, Engineering Design Synthesis [9], Chakrabarti also presents a survey and detailed investigation of the application of design synthesis such as generating a pattern of solutions with design synthesis. However, a Genetic Algorithm is not a silver bullet that can solve every problem in searching and optimization processes. Before using a GA, there are many selection methods that need to be preconsidered because selection is one of the most urgent operations in the processes [10]. Thus, to improve and optimize the GA usage, a pre-comparison study might be necessary to discover the most suitable selection method for a particular context of a case study. The previous studies [10] [11] [12] show that the Elitism and Roulette-Wheel selectors are the

most commonly used selection techniques. In most of the cases, Elitism shows a better performance than the other techniques based on a pre-defined context of the case studies.

This paper proposes a comparison study of both common GA selectors, Elitism and Roulette-Wheel. The primary contribution of this paper is to help the systems engineers to select the most suitable GA selector and in addition, assist them using the best fitness solution based on the fitness value pre-defined by the domain experts.

2. Literature Review

2.1. Overview of Genetic Algorithms

The Genetic Algorithm (GA) is inspired by Charles Darwin's Theory of Evolution [10], which illustrates the natural biological systems evolution and its natural selection [3]. Computer scientists have adopted this approach as a metaheuristic searching algorithms to solve optimization problems [11]. The searching method of GAs is mainly based on randomization with natural selection [12] Darwin's theory of evolution by natural selection means that the fittest individual will survive. The GA process starts with a sample set of potential solutions (initial population) [12] represented by chromosomes to produce a new population or the next generation. The process continues with two parent chromosomes within the population mate by sharing their genetic information [13]. The mating process of these two chromosomes to form the next generation is known as crossover. This crossover results in the offspring receiving a part of the genes from one parent chromosome and a part of the genes from the other parent. However, gene mutation may occur when copying of the parent's genetic information, which causes the genes of the new offspring to be slightly different from their parent chromosomes [13].

2.2. Selection Methods

Selection is also known as reproduction [13]. It is applied to a population to find the best chromosomes to be the parents [14]. From the population, the parent chromosomes are chosen to perform crossover and produce the potential offspring [13]. Elitism is one of the selection methods that copies the best chromosome of the previous population to the new one [14]. In addition, the chance of the current fittest chromosome to lose the best chromosome is high when producing a new population by performing crossover and mutation [14]. *Roulette-Wheel*, which is also known as the fitness proportional selector [15], is commonly used for selecting potentially useful solutions for recombination. Its method is very similar to how a roulette wheel rotates in a roulette game. The chance of an offspring to be selected is proportional to its fitness to the other competitors' fitness [13]. For example, (Figure 1), the Roulette-Wheel simulates 8 offspring and each fitness value marked around the wheel. The 5th offspring has the highest fitness value than the others; therefore, the chance of the 5th offspring to be selected is higher than that of the other offspring [13].



Figure 1 Roulette-Wheel Selector

2.3. Example of Application

This paper proposes a solution for the component-selection problem in the instance level of a hybrid car model. Figure 2 shows an example of a hybrid car model structure in a Block Definition Diagram. The hybrid car consists of an engine, an electric motor, and a battery. Since the main objective of this preliminary research is to show how the proposed technique can be applied to the design synthesis problem, only the simplified partial conceptual level hybrid car system design and a set of simplified formulas for calculating the solution with basic parameters, such as total horsepower, total cost, and total weight, are considered. Any complex system and formula can be used instead of the simplified version for future work, depending on the type of domain and industry. Only three important parameters, i.e., *totalHP*, *totalCost*, and *totalWeight* are considered in this

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research. These parameters are used to evaluate the system design's fitness using a fitness function. The details will be elaborated in the methodology section.



Figure 2 Example of a Hybrid Car Structure

3. Selection Methods of Genetic Algorithms in Design Synthesis

In Genetic Algorithms, evaluation involves measuring the fitness of a candidate solution. The analogy comes from Darwin's theory of evolution "The strongest species that survives" [13]. To do this, a fitness value is needed to define the quality of each gene in a population in order to perform a selection process [16]. A kind of measurement to derive the quality is called a fitness function [3] [16]. The purpose is to evaluate how close an individual is to an optimal solution [14]. According to the design, the model requirement parameters and the measures of effectiveness (MoE) are used to identify the best optimized value or the Fitness Value. Figure 3 shows that the evolutionary trade-off also needs a model of fitness function to perform the natural selection of GAs. It depicts the additional model for a hybrid car and its components. The GA parameters provide the code and the gene value for each battery, engine, and electric motor required by GA to do the evaluation. The Trade Study Analysis block includes the Fitness Function to analyze the Hybrid Car System Model. The Fitness Function block represents the model of the fitness value formula and includes the parameters required by GA.

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Figure 3 Trade Study Structure model with GA's parameter and Fitness Function

Table 1 shows the stakeholders' needs and the design parameters considered in the trade-off study: Performance, Cost, and Weight. The weighted ratio is used to define the weighted fitness function to evaluate the chromosomes.

Table 1 Requirements Example

Requirements	Value	Weight Ratio	
Target HP	140 hp	0.7	
Maximum Cost	US\$30,000	0.2	
Maximum Weight	700 kg	0.1	

Before measuring the fitness value, it is necessary to calculate the gained horsepower (hp), cost, and weight of the potential solution in the selection process. The following shows the examples of a hybrid car's performance calculation:

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totalCost=enginePrice+electricMotorPrice+batteryPrice	(2)	
totalWeight=engineWeight+electricMotorWeight+batteryWeight	(3)	

Whereas:

- totalHP is the total power of a solution in horsepower;
- totalCost is the total cost of a solution;
- totalWeight is the total mass of a solution.

In this GA, the authors use a Weighted Fitness Function to evaluate the solutions. The example of Weighted GA's Fitness Function is as follows:

Whereas:

- fitnessHP is the fitness value of the performance of a solution;
- fitnessCost is the fitness value of the cost of solution;
- fitnessWeight is the fitness value of the mass of a solution;
- w1, w2 and w3 are real positive weights, indicating the contribution of each fitness value to the overall fitness function whereas w1 + w2 + w3 = 1.

targetHP-totalHP	
nessHP= MAX _{BOUND}	
(totalCost≤maxCost)	
maxCost-totalCost	
maxCost maxCost	
lse	
nessCost= MIN _{BOUND}	
(totalWeight≦maxWeight)	
maxWeight-totalWeight	
maxWeight maxWeight	
lse	
nessWeight= MIN _{BOUND}	

Whereas:

- MINbound is the lowest bound of fitness value, 0.00;
- MAXbound is the highest bound of fitness value, 1.00;
- targetHP is the target performance of a solution in horsepower;
- maxCost is the maximum cost of a solution;
- maxWeight is the maximum mass of a solution.

The following are the Java code samples related to the fitness function evaluation.

public double evaluate(IChromosome a_subject) {

HybridCar hybCar = HybridCar.getHybridCarByChromosome(m_comLib,

a_subject);

```
double fitness = GAParameters.FITNESS_MIN_BOUND; // fitness scale is 0 to 1
/* 1. Calculate fitness for the greatest HP */
```

```
double hpDiff = Math.abs(m_req.getTARGET_HP() - hybCar.getTotalHp());
```

```
fitness += m_req.getRATIO_HP() * (GAParameters.FITNESS_MAX_BOUND -
```

(hpDiff / m_req.getTARGET_HP()));

/* End */

/* 2. Calculate fitness for the cheapest cost */

```
double costDiff = Math.abs(m_req.getMAX_COST() - hybCar.getTotalCost());
```

```
if (hybCar.getTotalCost() <= m_req.getMAX_COST()) {</pre>
```

```
fitness += m_req.getRATIO_COST() * (costDiff / m_req.getMAX_COST());
```

} else {

```
fitness = GAParameters.FITNESS_MIN_BOUND;
```

```
}
/* End */
```

/* 3. Calculate fitness for the lightest weight */

```
double weightDiff = Math.abs(m_req.getMAX_WEIGHT() -
```

hybCar.getTotalWeight());

```
if (hybCar.getTotalWeight() <= m_req.getMAX_WEIGHT()) {</pre>
```

}

```
fitness += m req.getRATIO WEIGHT() * (weightDiff /
m req.getMAX WEIGHT());
} else {
       fitness = GAParameters.FITNESS_MIN_BOUND;
}
/* End */
```

Before using GAs, it is important to define the ratio of the algorithm parameters and its target data encoding representation. There are several key operations in designing GAs to solve an optimization problem such as the representation and encoding technique, the initial population (how the first generation is generated), the selection method (how to select parent individuals to be involved in reproduction), the crossover operator (how to produce an offspring from two parent chromosomes), and the mutation operator (how to mutate offspring) [14]. Table 2 shows the GAs' parameters and their ratio.

Operators	Method	Rate	
Population Size	n/a	10	
Number of Evolutions	n/a	20	
Selection	Elitism	0.9	
	Roulette-Wheel	n/a	
Crossover	One-Point	0.35	
Mutation	Custom String Gene Mutation	12	

Table 2 The Genetic Algorithms' Parameters

In the initial prototype, the initial population is randomly generated by a random number generator to simulate the nature of evolutions [8]. However, if the systems engineers already had some potential designs from the previous experiences, they can use them as the initial population. The number of chromosomes in the initial population depends on the population size which is specified by the engineers.

Crossover is also known as recombination [16]. It is like simulating the "biological mating" of two parent chromosomes by swapping and mixing their genes [15] so that the parents can pass their genetic information to their offspring. The default configuration of the initial prototype is a one-point crossover. The one-point crossover locates a crossover point and then clones the everything behind this point from the first parent chromosome and then the rest after the crossover point from the second parent chromosome [16] [17]. The crossover point is chosen randomly with a probability rate of 0.35 of the specified

Mutation is the random changes of the gene values in the chromosomes of a potential solution [15]. The changes are mainly caused by errors in copying genes from the parent chromosomes [17]. After the crossover helps the parent chromosomes to produce their successors, the mutation is applied to each successor. By applying mutation, it can help retain the diversity of the individuals in the whole population [15] [16]. The default configuration of the initial prototype is a custom mutation for the string-typed gene at a rate of 12. It means that the mutation is applied to 1 in 12 genes in the whole population. It is often necessary to develop a custom type of mutation in value encoding [16]. The mutation is simply done by performing a change at the mutation point with another permitted string value. A set of the permitted string value is called permitted alphabet [15]. The rate is dictated by the size of the chromosome multiplied by the size of the population divided by the rate. Therefore, the probability of mutation rate is 1/12. The mutation point is random.

4. The Implementation of the Example

population size.

This paper used Cameo Systems Modeler (CSM), a modeling tool developed by No Magic, Inc., together with an open source library JGAP to perform the trade study to test the GA with SysML. With its open API and its SysML implementation, which is the most Object Management Group (OMG) standard-compliant, CSM allows us to access the model information and test the GA. The architecture of the GA plugin for Cameo Systems Modeler is shown in Figure 4.





Figure 4 GA Plugin for Cameo Systems Modeler Architecture

5. **Results of Evaluation**

The initial prototype involves 20 alternative components: 10 engines, 5 electric motors, and 5 batteries. Therefore, the total permutation of possible solutions is 250 for the trade study. The experiments performed two selection methods to simulate the evolutionary trade study based on the desired requirements (i.e., target power = 140 hp; maximum cost = US\$ 30,000; and maximum weight = 700 kg). The parameters used in this experiment are: Population Size = 10, Number of Evolution = 20, Crossover Rate = 0.35, Mutation Rate = 12, and Selection Rate is 90 percent with the Elitism approach.

The results (see Appendix) show that the Elitism selector is more suitable to use in this case study context than the Roulette-Wheel selector. The reason is that based on 100 experiments for each selector, the Elitism selector discovers a better solution with the closest fitness value (i.e., Engine A – Electric Motor D – Battery C with the fitness value = 0.802 out of 1.0) more frequently than the other one. The most optimized component configuration selected is the one made use of Elitism as the selection method (Figure 5) to

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keep the best alternative from the previous solution as the potential alternative for the next one.





6. Conclusions and Future Works

This paper demonstrated the genetic algorithm (GA) usage in the initial prototype to perform the evolutionary trade study in design synthesis by using the SysML model to specify the system structure and its requirements. By comparing both the Elitism and Roulette-Wheel selectors we found that Elitism has a better mutation performance and fitness value when used with the controlled system structure and requirements modeled in SysML as its constraint.

A single synthesis method cannot always solve every kind of problem [8]. Therefore, GA used in this paper should be reconfigured and optimized depending on the problem. GA can perform well in an initial prototype, but the prototype will always be much simpler than a real system because the real system requires much more specifications and detail, such as the interfaces between each components, parameters and items that need to flow through each connector, dimension of each component and part, etc. to control the mutation and ensure the selected components can be assembled. Also, the right fitness value and function requires different knowledge of each domain to optimize GA and make it perform accurately. For future research, the experimental results can be measured quantitatively using some statistical technique, such as correlative coefficient [16] and regression.

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Appendix

#	Name	P engine : Engine	P electricMotor : ElectricMotor	P battery : Battery	V totalHP : Real	v totalCost : Real	totalWeight : Real	👿 fitnessCar : Real
1	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
2	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
3	HybridCar_BCC	Engine B : 2 Logical Model::5	Electric Motor C : 2 Logical M	Battery C : 2 Logical Model:	137.0	14600.0	674.0	0.7913809523809523
4	HybridCar_BCC	Engine B : 2 Logical Model::5	Electric Motor C : 2 Logical M	Battery C : 2 Logical Model:	137.0	14600.0	674.0	0.7913809523809523
5	HybridCar_BCC	Engine B : 2 Logical Model::5	Electric Motor C : 2 Logical M	Battery C : 2 Logical Model:	137.0	14600.0	674.0	0.7913809523809523
6	HybridCar_BCC	Engine B : 2 Logical Model::5	Electric Motor C : 2 Logical M	Battery C : 2 Logical Model:	137.0	14600.0	674.0	0.7913809523809523
7	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
8	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
9	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
10	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
11	HybridCar_BCC	Engine B : 2 Logical Model::5	Electric Motor C : 2 Logical M	Battery C : 2 Logical Model:	137.0	14600.0	674.0	0.7913809523809523
12	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
13	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
14	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
15	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
16	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
17	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
18	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
19	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
20	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
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23	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
24	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
25	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
26	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
27	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
28	HybridCar_ADC	Engine A : 2 Logical Model: :	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
29	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
30	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
31	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
32	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
33	HybridCar_BCC	Engine B : 2 Logical Model::5	Electric Motor C : 2 Logical M	Battery C : 2 Logical Model::	137.0	14600.0	674.0	0.7913809523809523
34	HybridCar_ADC	Engine A : 2 Logical Model::	🗉 Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
35	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
36	HybridCar_BCC	Engine B : 2 Logical Model::5	Electric Motor C : 2 Logical M	Battery C : 2 Logical Model:	137.0	14600.0	674.0	0.7913809523809523
37	HybridCar_ADC	Engine A : 2 Logical Model::	🖃 Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
38	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
39	HybridCar_BCC	Engine B : 2 Logical Model::5	Electric Motor C : 2 Logical M	Battery C : 2 Logical Model:	137.0	14600.0	674.0	0.7913809523809523
40	HybridCar_ADC	Engine A : 2 Logical Model:::	🗉 Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
41	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
42	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
43	HybridCar_ADC	Engine A : 2 Logical Model::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
44	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
45	HybridCar_BCC	Engine B : 2 Logical Model::5	Electric Motor C : 2 Logical M	Battery C : 2 Logical Model:	137.0	14600.0	674.0	0.7913809523809523
46	HybridCar_ADC	Engine A : 2 Logical Model:::	🖃 Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
47	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
48	HybridCar_ADC	Engine A : 2 Logical Model: ::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
49	HybridCar_ADC	Engine A : 2 Logical Model:::	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model:	138.0	15400.0	594.0	0.8024761904761905
50	HybridCar_BCC	Engine B : 2 Logical Model::5	Electric Motor C : 2 Logical M	Battery C: 2 Logical Model:	137.0	14600.0	674.0	0.7913809523809523

Figure A1 Experimental Results of the Elitism Selector Part 1

#	Name	engine : Engine	electricMotor : ElectricMotor	Dattery : Battery	👿 totalHP : Real	totalCost : Real	v totalWeight : Real	💽 fitnessCar : Real
51	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	🖃 Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
52	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	🖾 Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
53	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	🖃 Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
54	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	🖃 Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
55	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	🖃 Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
56	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
57	HybridCar_ADC	Engine A : 2 Logical Model::S	🖃 Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
58	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
59	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
60	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
61	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
62	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C: 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
63	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
64	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
65	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
66	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
67	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
68	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
69	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
70	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
71	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
72	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	🖃 Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
73	HybridCar_ADC	Engine A : 2 Logical Model::S	🖃 Electric Motor D : 2 Logical M	🖃 Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
74	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
75	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
76	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	🖃 Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
77	HybridCar_BCC	Engine B : 2 Logical Model::S	Electric Motor C : 2 Logical M	🖃 Battery C : 2 Logical Model::	137.0	14600.0	674.0	0.7913809523809523
78	HybridCar_BCC	Engine B : 2 Logical Model::S	🖃 Electric Motor C : 2 Logical M	Battery C : 2 Logical Model::	137.0	14600.0	674.0	0.7913809523809523
79	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
80	HybridCar_BCC	Engine B : 2 Logical Model::S	Electric Motor C : 2 Logical M	Battery C : 2 Logical Model::	137.0	14600.0	674.0	0.7913809523809523
81	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	🖃 Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
82	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
83	HybridCar_ADC	Engine A : 2 Logical Model::S	😑 Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
84	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
85	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
86	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
87	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
88	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
89	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
90	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
91	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
92	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
93	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
94	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
95	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
96	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
97	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
98	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
99	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905
100	HybridCar_ADC	Engine A : 2 Logical Model::S	Electric Motor D : 2 Logical M	🖾 Battery C : 2 Logical Model::	138.0	15400.0	594.0	0.8024761904761905

Figure A2 Experimental Results of the Elitism Selector Part 2

#	Name	engine : Engine	electricMotor : ElectricMotor	Dattery : Battery	▼ totalHP : Real	V totalCost : Real	totalWeight : Real	⊡ fitnessCar : Real
1	HybridCar_FEB	Engine F : 2 Logical Mo	Electric Motor E : 2 Log	Battery B : 2 Logical Mo	148.0	17700.0	992.0	0.0
2	HybridCar_ADB	Engine A : 2 Logical Mo	Electric Motor D : 2 Log	Battery B : 2 Logical Mo	138.0	15200.0	605.0	0.8022380952380952
3	HybridCar_JBE	🖃 Engine J : 2 Logical Mo	📼 Electric Motor B : 2 Log	🖃 Battery E : 2 Logical Mo	144.0	20500.0	1112.0	0.0
4	HybridCar_ADA	Engine A : 2 Logical Mo	Electric Motor D : 2 Log	Battery A : 2 Logical Mc	138.0	15000.0	620.0	0.8014285714285714
5	HybridCar_ADC	Engine A : 2 Logical Mo	📼 Electric Motor D : 2 Log	🖃 Battery C : 2 Logical Mc	138.0	15400.0	594.0	0.8024761904761905
6	HybridCar_ACE	Engine A : 2 Logical Mo	📼 Electric Motor C : 2 Log	Battery E : 2 Logical Mo	125.0	16000.0	656.0	0.7246190476190477
7	HybridCar_BDB	Engine B : 2 Logical Mo	Electric Motor D : 2 Log	📼 Battery B : 2 Logical Mo	150.0	15400.0	700.0	0.74733333333333334
8	HybridCar_BCC	🖃 Engine B : 2 Logical Mo	Electric Motor C : 2 Log	Battery C : 2 Logical Mc	137.0	14600.0	674.0	0.7913809523809523
9	HybridCar_ADC	Engine A : 2 Logical Mo	🖃 Electric Motor D : 2 Log	Battery C : 2 Logical Mc	138.0	15400.0	594.0	0.8024761904761905
10	HybridCar_AEC	🖃 Engine A : 2 Logical Mo	📼 Electric Motor E : 2 Log	🖃 Battery C : 2 Logical Mc	148.0	16400.0	614.0	0.7629523809523808
11	HybridCar_JBB	🖃 Engine J : 2 Logical Mo	📼 Electric Motor B : 2 Log	🖃 Battery B : 2 Logical Mo	144.0	18700.0	1046.0	0.0
12	HybridCar_AAB	Engine A : 2 Logical Mo	😑 Electric Motor A : 2 Log	🖃 Battery B : 2 Logical Mo	98.0	12200.0	555.0	0.6293809523809523
13	HybridCar_CBC	Engine C : 2 Logical Mo	📼 Electric Motor B : 2 Log	Battery C : 2 Logical Mc	120.0	13900.0	690.0	0.7087619047619048
14	HybridCar_CBC	🖃 Engine C : 2 Logical Mo	📼 Electric Motor B : 2 Log	🖃 Battery C : 2 Logical Mc	120.0	13900.0	690.0	0.7087619047619048
15	HybridCar_JBE	Engine J : 2 Logical Mo	Electric Motor B : 2 Log	🖃 Battery E : 2 Logical Mo	144.0	20500.0	1112.0	0.0
16	HybridCar_ADA	Engine A : 2 Logical Mo	📼 Electric Motor D : 2 Log	Battery A : 2 Logical Mc	138.0	15000.0	620.0	0.8014285714285714
17	HybridCar_AAA	Engine A : 2 Logical Mo	Electric Motor A : 2 Log	🖃 Battery A : 2 Logical Mc	98.0	12000.0	570.0	0.6285714285714284
18	HybridCar_BBC	Engine B : 2 Logical Mo	📼 Electric Motor B : 2 Log	Battery C : 2 Logical Mc	114.0	13600.0	650.0	0.6864761904761905
19	HybridCar_ACA	Engine A : 2 Logical Mo	😑 Electric Motor C : 2 Log	Battery A : 2 Logical Mc	125.0	14000.0	605.0	0.7452380952380953
20	HybridCar_ACE	Engine A : 2 Logical Mo	📼 Electric Motor C : 2 Log	📼 Battery E : 2 Logical Mo	125.0	16000.0	656.0	0.7246190476190477
21	HybridCar_CAB	🖃 Engine C : 2 Logical Mo	📟 Electric Motor A : 2 Log	🖃 Battery B : 2 Logical Mo	116.0	12700.0	690.0	0.6967619047619048
22	HybridCar_BCB	🖃 Engine B : 2 Logical Mo	📼 Electric Motor C : 2 Log	🖃 Battery B : 2 Logical Mo	137.0	14400.0	685.0	0.791142857142857
23	HybridCar_HEE	😑 Engine H : 2 Logical Mo	📼 Electric Motor E : 2 Log	🖃 Battery E : 2 Logical Mo	166.0	22000.0	1136.0	0.0
24	HybridCar_CAC	🖃 Engine C : 2 Logical Mo	🚍 Electric Motor A : 2 Log	🖃 Battery C : 2 Logical Mc	116.0	12900.0	679.0	0.697
25	HybridCar_ACC	Engine A : 2 Logical Mo	📼 Electric Motor C : 2 Log	🖂 Battery C : 2 Logical Mc	125.0	14400.0	579.0	0.7462857142857142
26	HybridCar_CAB	Engine C : 2 Logical Mo	Electric Motor A : 2 Log	Battery B : 2 Logical Mo	116.0	12700.0	690.0	0.6967619047619048
27	HybridCar_CAC	Engine C : 2 Logical Mo	Electric Motor A : 2 Log	Battery C : 2 Logical Mc	116.0	12900.0	679.0	0.697
28	HybridCar_BCB	Engine B : 2 Logical Mo	📼 Electric Motor C : 2 Log	Battery B : 2 Logical Mo	137.0	14400.0	685.0	0.791142857142857
29	HybridCar_CBC	Engine C : 2 Logical Mo	📼 Electric Motor B : 2 Log	Battery C : 2 Logical Mc	120.0	13900.0	690.0	0.7087619047619048
30	HybridCar_CAB	Engine C : 2 Logical Mo	Electric Motor A : 2 Log	Battery B : 2 Logical Mo	116.0	12700.0	690.0	0.6967619047619048
31	HybridCar_BDC	Engine B : 2 Logical Mo	Electric Motor D : 2 Log	Battery C : 2 Logical Mc	150.0	15600.0	689.0	0.7475714285714286
32	HybridCar_BCB	Engine B : 2 Logical Mo	Electric Motor C : 2 Log	Battery B : 2 Logical Mo	137.0	14400.0	685.0	0.791142857142857
33	HybridCar_BBC	Engine B : 2 Logical Mo	Electric Motor B : 2 Log	Battery C : 2 Logical Mc	114.0	13600.0	650.0	0.6864761904761905
34	HybridCar_ADE	Engine A : 2 Logical Mo	Electric Motor D : 2 Log	Battery E : 2 Logical Mo	138.0	17000.0	671.0	0.7808095238095237
35	HybridCar_ADC	Engine A : 2 Logical Mc	Electric Motor D : 2 Log	Battery C : 2 Logical Mc	138.0	15400.0	594.0	0.8024761904761905
36	HybridCar_DCE	Engine D : 2 Logical Mo	Electric Motor C : 2 Log	Battery E : 2 Logical Mo	165.0	17000.0	916.0	0.0
37	HybridCar_BCC	Engine B : 2 Logical Mo	Electric Motor C : 2 Log	Battery C : 2 Logical Mc	137.0	14600.0	674.0	0.7913809523809523
38	HybridCar_ADA	Engine A : 2 Logical Mc	Electric Motor D : 2 Log	Battery A : 2 Logical Mc	138.0	15000.0	620.0	0.8014285714285714
39	HybridCar_ADE	Engine A : 2 Logical Mo	Electric Motor D : 2 Log	Battery E : 2 Logical Mo	138.0	17000.0	671.0	0.7808095238095237
40	HybridCar_HBC	Engine H : 2 Logical Mo	Electric Motor B : 2 Log	Battery C : 2 Logical Mc	120.0	17400.0	1000.0	0.0
41	HybridCar_BDB	Engine B : 2 Logical Mo	Electric Motor D : 2 Log	Battery B : 2 Logical Mo	150.0	15400.0	700.0	0.74733333333333334
42	HybridCar_HAE	Engine H : 2 Logical Mo	Electric Motor A : 2 Log	Battery E : 2 Logical Mo	116.0	18000.0	1066.0	0.0
43	HybridCar_HED	Engine H : 2 Logical Mc	Electric Motor E : 2 Log	Battery D : 2 Logical Mc	166.0	20500.0	1070.0	0.0
44	HybridCar_AEC	El Engine A : 2 Logical Mo	Electric Motor E : 2 Log	Battery C : 2 Logical Mc	148.0	10400.0	614.0	0.7629523809523808
45	HybridCar_BCC	El Engine B : 2 Logical Mo	Electric Motor C : 2 Log	Battery C : 2 Logical Mc	137.0	14600.0	0/4.0	0.7913809523809523
46	HypridCar_DCE	Engine D : 2 Logical Mc	Electric Motor C : 2 Log	Battery E : 2 Logical Mo	165.0	1/000.0	916.0	0.0
47	HybridCar_CAC	Engine C : 2 Logical Mo	Electric Motor A : 2 Log	Battery C : 2 Logical Mc	116.0	12900.0	6/9.0	0.69/
48	HybridCar_AEB	El Engine A : 2 Logical Mo	Electric Motor E : 2 Log	Battery B : 2 Logical Mo	148.0	16200.0	625.0	0.762/14285/142856
49	HypridCar_DCE	Engine D : 2 Logical Mc	Electric Motor C : 2 Log	Battery E : 2 Logical Mo	0.00	1/000.0	910.0	0.0
50	HybridCar_AAE	Engine A : 2 Logical Mc	Electric Motor A : 2 Log	🖽 Battery E : 2 Logical Mo	98.0	14000.0	021.0	0.0079523809523808

Figure A3 Experimental Results of the Roulette-Wheel Selector Part 1

May 2nd- 4th, 2018, Ambassador Hotel Bangkok, Thailand

1 1 1 1 1 0	#	Name	Pengine : Engine electricMotor : ElectricMotor : ElectricMotor	ery 🔽 totalHP : Real	TotalCost : Real	☑ totalWeight : Real	☐ fitnessCar : Real
20 Implicit I	51	HybridCar_ACE	📼 Engine A : 2 Logical Mc 📼 Electric Motor C : 2 Log 📼 Battery E : 2 Log	ical Mo 125.0	16000.0	656.0	0.7246190476190477
Si Imput AL Impu AL Impu AL <thimpu al<="" th=""> <thimpu al<="" th=""> <thimpu al<<="" td=""><td>52</td><td>HybridCar_ADC</td><td>🚍 Engine A : 2 Logical Mc 🚍 Electric Motor D : 2 Log 🚍 Battery C : 2 Log</td><td>ical Mc 138.0</td><td>15400.0</td><td>594.0</td><td>0.8024761904761905</td></thimpu></thimpu></thimpu>	52	HybridCar_ADC	🚍 Engine A : 2 Logical Mc 🚍 Electric Motor D : 2 Log 🚍 Battery C : 2 Log	ical Mc 138.0	15400.0	594.0	0.8024761904761905
94 Myddar/Lett Employee 1: 2 Logidal Mole Effectic Meter 2: Logid Mathy 4: 2 Logidal Mole 2000. 111.2.0 0.002/0769076305 95 Myddar/Latt Employee 1: 2 Logidal Mole Effectic Meter 2: Logid Mathy 2: 2 Logidal Mole 2000. 594.0 0.002/0769076305 95 Myddar/Latt Employee 1: Logidal Mole Effectic Meter 2: Logid Mathy 3: 2 Logidal Mole 2000. 594.0 0.002/0769076305 95 Myddar/Latt Employee 1: Logidal Mole Effectic Meter 2: Logid Mathy 3: Logidal Mole 2000. 594.0 0.002/0769076305 95 Myddar/Latt Employee 1: Logidal Mole Effectic Meter 2: Logid Mathy 2: Logidal Mol22.0 1500.00 650.0 0.02249097109077 00 Myddar/Latt Employee 1: Logidal Mole Effectic Meter 2: Logid Mathy 2: Logidal Mol22.0 1500.00 650.0 0.02249097109077 01 Myddar/Latt Employee 1: Logidal Mole Effectic Meter 2: Logid Mal22.0 1500.00 650.0 0.02249097309072 02 Myddar/Latt Employee 1: Logidal Mole Effectic Meter 2: Logid Mal23.0 1500.0 650.0 0.022490730972 03 Myddar/Latt Employee 1: Logidal Mole Effectic Meter 2: Logid Mal23.0 1500.0 650.0 0.0224907497171 <tr< td=""><td>53</td><td>HybridCar_AEE</td><td>🖃 Engine A : 2 Logical Mc 🖃 Electric Motor E : 2 Log 🖃 Battery E : 2 Log</td><td>ical Mo 148.0</td><td>18000.0</td><td>691.0</td><td>0.7412857142857143</td></tr<>	53	HybridCar_AEE	🖃 Engine A : 2 Logical Mc 🖃 Electric Motor E : 2 Log 🖃 Battery E : 2 Log	ical Mo 148.0	18000.0	691.0	0.7412857142857143
Si HybridZ, ADC Engine A: 21.000 MC Engine A: 21.000 MC Engine A: 21.000 MC Engine B: 21.000 MC Engine A: 21	54	HybridCar_JBE	🖃 Engine J : 2 Logical Mo 🚍 Electric Motor B : 2 Log 🚍 Battery E : 2 Log	ical Mo 144.0	20500.0	1112.0	0.0
Set HybridStr.ADC Emple A: 21 cold Mc Emeter Moto 7: 21 cold Bettery 7: 21 cold Mc M370 HybridStr.ADC Bitter Mc MC 21 cold Bettery 7: 21 cold Mc M370 HybridStr.ADC Bitter MC MC 21 cold Bettery 7: 21 cold Mc M370 HybridStr.ADC Bitter MC MC 21 cold Bettery 7: 21 cold Mc M300 HybridStr.ADC Bitter MC MC 21 cold Bettery 7: 21 cold Mc M300 HybridStr.ADC Bitter MC MC 21 cold Bettery 7: 21 cold Mc M300 HybridStr.ADC Bitter MC MC 21 cold Bettery 7: 21 cold Mc M300 HybridStr.ADC Bitter MC MC 21 cold Bettery 7: 21 cold Mc M300 HybridStr.ADC Bitter MC MC 21 cold Better MC MC 2: 21 cold Bettery 7: 21 cold Mc M300 HybridStr.ADC Bitter MC MC 21 cold Better MC MC 2: 21 cold Mc M300 HybridStr.ADC Bitter MC MC 2: 20 cold Mc MC MC MC 2: 20 cold Mc M300 HybridStr.ADC Bitter MC MC 2: 20 cold Mc MC MC 2: 20 cold Mc M300 HybridStr.ADC Bitter MC MC 2: 20 cold Mc MC MC 2: 20 cold Mc M300 HybridStr.ADC Bitter MC MC 2: 20 cold Mc MC MC 2: 20 cold Mc M300 HybridStr.ADC Bitter MC MC 2: 20 cold Mc MC MC 2: 20 cold Mc M300 HybridStr.ADC Bitter MC MC 2: 20 cold Mc MC MC 2: 20 cold Mc M300 HybridStr.ADC Bitter MC MC 2: 20 cold Mc MC MC 2: 20 cold Mc M300 HybridStr.ADC Bitter MC MC 2: 20 cold Mc MC 2: 20 cold Mc M200 HybridStr.ADC HybridStr.ADC Bitter MC MC 2: 20 cold Mc MC 2: 20 cold Mc M200 HybridStr.ADC HybridStr.ADC H	55	HybridCar_ADC	🖃 Engine A : 2 Logical Mc 🚍 Electric Motor D : 2 Log 🚍 Battery C : 2 Log	ical Mc 138.0	15400.0	594.0	0.8024761904761905
97 97 8 Phythick 97 97	56	HybridCar_ADC	🖃 Engine A : 2 Logical Mc 🚍 Electric Motor D : 2 Log 🚍 Battery C : 2 Log	ical Mc 138.0	15400.0	594.0	0.8024761904761905
Set Explorida Set Add	57	HybridCar_BCB	Engine B : 2 Logical Mo Electric Motor C : 2 Log E Battery B : 2 Log	ical Mo 137.0	14400.0	685.0	0.791142857142857
99 91<	58	HybridCar_ADC	Engine A : 2 Logical Mc Electric Motor D : 2 Log Electric C : 2 Log	ical Mc 138.0	15400.0	594.0	0.8024761904761905
60 Exploride Endprint A: 2 Logial ME Electric Mator 1: 2 Logi Retury 2: 1 Logial ME130 500.0 605.0 0.8023899238992 61 Exploride Endprint A: 1 Logial ME Electric Mator 1: 2 Logi Retury 2: 1 Logial ME130 1500.0 665.0 0.8023899238992 62 Exploride Endprint A: 1 Logial ME Electric Mator 1: 2 Logi Retury 1: 2 Logial ME130 1500.0 660.0 0.8023899238992 63 Endprint B: Logial ME Electric Mator 1: 2 Logi Retury 1: 2 Logial ME130 1500.0 680.0 0.7475148857148857 64 Endprint C: Logial ME1 Electric Mator 1: 2 Logi Retury 1: 2 Logial ME130 1500.0 680.0 0.8022899238992 65 Endprint C: Logial ME1 Electric Mator 1: 2 Logi Retury 1: 2 Logial ME130 1500.0 680.0 0.8022899238992 66 Endprint C: Logial ME1 Electric Mator 1: 2 Logial ME130 1500.0 680.0 0.8022899238992 67 Endprint C: Logial ME1 Electric Mator 1: 2 Logial ME130 1500.0 680.0 0.8022899238992 68 Endprint C: Logial ME1 Electric Mator 1: 2 Logial ME130 1500.0 680.0 0.74761	59	HybridCar_AEC	Engine A : 2 Logical Mc Electric Motor E : 2 Log E Battery C : 2 Log	ical Mc 148.0	16400.0	614.0	0.7629523809523808
61 = Inderic A: 2. Logical Mc Electric Motor C: 2. Logical Mc123.0 1000.0 650.0 0.72461097619077 62 = HydricKa: JBC = Engine A: 2. Logical Mc Electric Motor C: 2. Logical Mc13.0 1500.0 650.0 0.89229952280972 63 = HydricKa: JBC = Engine A: 2. Logical Mc Electric Motor D: 2. Logical Mc13.0 1560.0 680.0 0.89247613997619957 64 = HydricKa: JBC = Engine A: 2. Logical Mc Electric Motor D: 2. Logical Mc13.0 1560.0 680.0 0.89247613997619957 65 = HydricKa: JBC = Engine A: 2. Logical Mc Electric Motor D: 2. Logical Mc13.0 1560.0 670.0 0.892289572289572 66 = HydricKa: JBC = Engine A: 2. Logical Mc Electric Motor D: 2. Logical Mc13.0 15700.0 670.0 0.8922895724957148 70 = HydricKa: JBC = Engine A: 2. Logical Mc12.0 Electric Motor D: 2. Logical Mc13.0 15700.0 670.0 0.0 71 = HydricKa: JBC = Engine A: 2. Logical Mc12.0 Electric Motor D: 2. Logical Mc13.0 15700.0 670.0 0.724619907599477 72 = HydricKa: JBC = Engine A: 2. Logical Mc12.0 Electric Motor D: 2. Logical Mc12.0 157	60	HybridCar_ADD	Engine A : 2 Logical Mc Electric Motor D : 2 Log Electric D : 2 Log	ical Mc138.0	15500.0	605.0	0.8002380952380952
G2 ImplyIndCx_ADD Engine A: 2 Logical Mole Electric Motor D: 2 Logical Mol13.0. 15200.0 650.0 0.80627389762. G4 ImplyIndCx_ADC Engine A: 2 Logical Mol Electric Motor D: 2 Logical Mol13.0. 15600.0 640.0 0.804745199761905 G4 ImplyIndCx_ADC Engine A: 2 Logical Mol Electric Motor D: 2 Logical Mol13.0. 15600.0 6470.0 0.8047451994761905 G4 ImplyIndCx_C Engine A: 2 Logical Mole Electric Motor D: 2 Logical Mol13.0. 15000.0 650.0 0.802289528952 G4 ImplyIndCx_C Engine A: 2 Logical Mole Electric Motor D: 2 Logical Mol13.0. 15000.0 650.0 0.802288528952 G4 ImplyIndCx_ADE Engine A: 2 Logical Mole Electric Motor D: 2 Logical Mol13.0. 15000.0 650.0 0.802485714928714 G4 ImplyIndCx_ADE Engine A: 2 Logical Mol Electric Motor D: 2 Logical Mol12.0. 15000.0 650.0 0.708719977199749797 G4 ImplyIndCx_ADE Engine A: 2 Logical Mol2 Electric Motor D: 2 Logical Mol12.0. 15000.0 670.0 0.70871997719974 G4 ImplyIndCx_ADE Engine A: 2 Logical Mol2 Electric Motor D: 2 Logical Mol12.0. 15000.0 670.0	61	HybridCar_ACE	🖃 Engine A : 2 Logical Mc 🖃 Electric Motor C : 2 Log 🖼 Battery E : 2 Log	ical Mo 125.0	16000.0	656.0	0.7246190476190477
62 Engine 8: 2 Logical Mo Endine Moor 9: 2 Logical Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0 Endine Moor 9: 2 Logical Moor 9: 2 Logical Moor 9: 2 Logical Moi 10: 0	62	HybridCar_ADB	🖃 Engine A : 2 Logical Mc 🚍 Electric Motor D : 2 Log 🚍 Battery B : 2 Log	ical Mo 138.0	15200.0	605.0	0.8022380952380952
effect Engine A: 2 Logical Mc Ender: Nature D: 2 Logical Bittery C: 2 Logical Mc/18.0 15400.0 594.0 0.897471594716965 66 I HyhridCar, CAC Engine C: 2 Logical MC = Ender: Nature D: 2 Logical Bittery C: 2 Logical Mc/18.0 12900.0 690.0 0.475715485714265 66 I HyhridCar, ADB Engine A: 2 Logical MC = Ender: Nature D: 2 Logical Bittery C: 2 Logical Mc/18.0 12900.0 690.0 0.80224895218052 67 I HyhridCar, ADB Engine A: 2 Logical MC = Ender: Mator A: 2 Logical Bittery C: 2 Logical Mc/18.0 12900.0 690.0 0.8022489754285714 68 I HyhridCar, EEE Engine A: 2 Logical MC = Ender: Mator A: 2 Logical Bittery C: 2 Logical Mc/18.0 14000.0 690.0 0.7026751907619968 71 I HyhridCar, AEE Engine A: 2 Logical MC = Ender: Mator A: 2 Logical Bittery C: 2 Logical Mc/12.0 16000.0 690.0 0.7026751907619968 72 I HyhridCar, AEE Engine A: 2 Logical MC = Ender: Mator A: 2 Logical Bittery C: 2 Logical Mc/12.0 15000.0 690.0 0.70267519076199647 72 I HyhridCar, AEE Engine A: 2 Logical MC = Ender: Mc or 2: Logical Mc/12.0 15000.0 690.0 0.70267519076199647 72 HyhridCa	63	HybridCar_BBC	Engine B : 2 Logical Mo Electric Motor B : 2 Log E Battery C : 2 Log	ical Mc 114.0	13600.0	650.0	0.6864761904761905
65 Empire B: 2 Logical Mo Electric Nator D: 2 Logical Mpc12 Logical Mpc12 Logical Mpc12 Logical Mpc130. 1560.0 690.0 697.0 66 Empire M: 2 Logical Mpc1 Electric Nator A: 2 Logical Mpc12 Logical Mpc130. 15200.0 690.0 0.8022389952380952 68 Empire A: 2 Logical Mpc1 Electric Nator D: 2 Logical Battery A: 2 Logical Mp130.0 15200.0 680.0 0.8022389952380952 68 Empire A: 2 Logical Mpc1 Electric Nator D: 2 Logical Battery A: 2 Logical Mp130.0 15000.0 680.0 0.8022389952380952 68 Empire A: 2 Logical Mpc1 Electric Nator B: 2 Logical Battery C: 2 Logical Mp130.0 15000.0 690.0 0.702619074719984 69 HybridCar_RCR Empire A: 2 Logical Mp11 Electric Nator B: 2 Logical Battery C: 2 Logical Mp120.0 15900.0 690.0 0.70261907419984 72 HybridCar_RCR Empire B: 2 Logical Mp12 Electric Nator B: 2 Logical Battery C: 2 Logical Mp120.0 15900.0 700.0 0.70261907419984 73 HybridCar_RCR Empire B: 2 Logical Mp12 Electric Nator B: 2 Logical Battery D: 2 Logical Mp130.0 15900.0 690.0 0.708761907419944 74 HybridCar_RCR Empire B: 2 Logical Mp12 Electric Nator B 2 Logical Battery D: 2 Logical Mp130.0	64	HybridCar_ADC	Engine A : 2 Logical Mc Electric Motor D : 2 Log Battery C : 2 Log	ical Mc 138.0	15400.0	594.0	0.8024761904761905
66 Employed Struct Control Contro Control Control	65	HybridCar_BDC	Engine B : 2 Logical Mo Electric Motor D : 2 Log Battery C : 2 Log	Ical Mc 150.0	15600.0	689.0	0.7475714285714286
of P Engine A: 2 Logical Mc Entric Motor D: 2 Logical Battery B: 2 Logical Mc138.0 IS200.0	66	HybridCar_CAC	Engine C : 2 Logical Mo Electric Motor A : 2 Log E Battery C : 2 Log	ical Mc 116.0	12900.0	679.0	0.697
isis bipktifdar_LADA Engine 1: 2 Logical Mc Electric Motor 0: 2 Logical Motile Electric Motor 0: 2 Logical Motile 12.0.0 14700.0 85.0 0.0 0 Dinybritdar_LCCC Engine 1: 2 Logical Motile Electric Motor 0: 2 Logical BMC 12.0.0 1600.0 660.0 0.708751047610481 12 Dinybritdar_LCCC Engine 1: 2 Logical Motile Electric Motor 0: 2 Logical BMC 12.0.0 1600.0 660.0 0.708751047610487 12 Dinybritdar_LCCC Engine 2: 2 Logical Motile Electric Motor 0: 2 Logical BMC 12.0.0 1600.0 660.0 0.008761047610483 13 Dinybritdar_LCCC Engine 2: Logical Motile Electric Motor 0: 2 Logical BMC 12.0.0 1500.0 767.0 0.0 14 Dinybritdar_LCCC Engine 2: Logical Motile Electric Motor 0: 2 Logical BMC 12.0.0 1500.0 700.0 0.047610478 15 Dinybritdar_LCCC Engine 2: Logical Motile Electric Motor 0: 2 Logical BMC 12.0.0 1500.0 700.0 0.04745104761048 16 Hybritdar_LCCC Engine 2: Logical Motile Electric Motor 0: 2 Logical BMC 12.0.0 1500.0 600.0 0.04745104761048 16 Hybritdar_LCCC Engine 2: Logical Motile Electric Motor 0: 2 Logical BMC 12.0.	67	HybridCar_ADB	Engine A : 2 Logical Mc Electric Motor D : 2 Log Battery B : 2 Log	ical Mo 138.0	15200.0	605.0	0.8022380952380952
69 Impleticar_EAB Engine E : Logical Mo Electric Motor A : Logical Mo Electric Motor A : Logical Mo Electric Motor B : Logical Mo Electric Motor B : Logical Mo Description 70 Impleticar_ECB Engine A : Logical Mo Electric Motor B : Logical Mo/E Electric Mo/E B : Logical Mo/E Elec	68	HybridCar_ADA	Engine A : 2 Logical Mc Electric Motor D : 2 Log E Battery A : 2 Loc	ical Mc 138.0	15000.0	620.0	0.8014285714285714
70 Engine C : 2 Logical Mo Electric Motor B : 2 Log Battery C : 2 Logical Mo (2000) 1990.0 690.0 0.76676190476190477 21 In hybridGar_ACC Engine A : 2 Logical Mo (2000) Electric Motor C : 2 Log Battery F : 2 Logical Mo (2000) 1600.0 656.0 0.7246190476190477 21 InhybridGar_ACC Engine C : 2 Logical Mo (2000) Battery F : 2 Logical Mo (2000) 1420.0 700.0 0.7087519047619048 21 InhybridGar_ACC Engine C : 2 Logical Mo (2000) Battery F : 2 Logical Mo (2000) 1590.0 700.0 0.7487519047619048 25 InhybridGar_ACD Engine C : 2 Logical Mo (2000) Battery F : 2 Logical Mc120.0 1590.0 700.0 0.7487519047619048 70 InhybridGar_ACD Engine F : 2 Logical Mo (2000) Battery F : 2 Logical Mo (100.0 1590.0 670.0 0.0 74333333333333333333333333333333333333	69	HybridCar_EAB	Engine E : 2 Logical Mo Electric Motor A : 2 Log Battery B : 2 Log	ical Mo 140.0	14700.0	855.0	0.0
71 Engine A : 2 Logical Mc Electric Motor C : 2 Logical Motor 2: 2 Log	70	HybridCar_CBC	Engine C : 2 Logical Mo Electric Motor B : 2 Log E Battery C : 2 Log	ical Mc 120.0	13900.0	690.0	0.7087619047619048
22 Important HybridGar_BCA Engine B: 2 Logical Mo Electric Motor C: 2 Logical Mc137.0 14200.0 700.0 0.79033333333333 23 Important Engine C: 2 Logical Mo Electric Motor B: 2 Logical Mc137.0 15500.0 767.0 0.0 24 HybridGar_BCB Engine C: 2 Logical Mo Electric Motor B: 2 Logical Mc137.0 15500.0 767.0 0.0 25 HybridGar_BDD Engine C: 2 Logical Mo Electric Motor D: 2 Logical Mc130.0 15700.0 700.0 0.745333333333333 76 HybridGar_BDD Engine C: 2 Logical Mo Electric Motor D: 2 Logical Mc150.0 15700.0 970.0 0.0 0.745333333333333333333333333333333333333	71	HybridCar ACE	Engine A : 2 Logical Mc Electric Motor C : 2 Log E Battery E : 2 Log	ical Mo 125.0	16000.0	656.0	0.7246190476190477
72 I HybridCar_CBE Engine C: 2 Logical Mo Electric Motor B: 2 Logi Battery C: 2 Logical Mo Electric Motor B: 2 Logi Battery C: 2 Logical Mo Electric Motor B: 2 Logi Battery C: 2 Logical Mo Electric Motor B: 2 Logi Battery C: 2 Logical Mo Electric Motor B: 2 Logi Battery C: 2 Logical Mo Electric Motor B: 2 Logical Mo Electric Motor D: 2 Logical Mc Electric Motor D: 2 Logical	72	HybridCar_BCA	Engine B : 2 Logical Mo Electric Motor C : 2 Log Battery A : 2 Log	ical Mc137.0	14200.0	700.0	0.790333333333333333
24 HybridCar_CBC Engine C: 2 Logical Mo Engine B: 2 Logical Mo Engine C: 2 Logical Mo	73	HybridCar_CBE	Engine C : 2 Logical Mo Electric Motor B : 2 Log Battery E : 2 Log	ical Mo 120.0	15500.0	767.0	0.0
25 I HybridGar_BDD Engine B : 2 Logical Mo Electric Motor D : 2 Logical Mo 150.0 1570.0 700.0 0.44533333333344 76 II HybridGar_CDD Engine E : 2 Logical Mo Electric Motor D : 2 Logical Battery D : 2 Logical Mo 150.0 1570.0 971.0 0.0 77 II HybridGar_CDD Engine C : 2 Logical Mo Electric Motor D : 2 Logical Battery D : 2 Logical Mo 150.0 1500.0 650.0 0.6947619047619048 78 I HybridGar_CAB Engine A : 2 Logical Mo Electric Motor C : 2 Logical Mo 152.0 14200.0 590.0 0.746447619047619048 79 I HybridGar_CAB Engine A : 2 Logical Mo Electric Motor C : 2 Logical Battery B : 2 Logical Mo 152.0 14200.0 590.0 0.746497619047619048 80 HybridGar_CAE Engine B : 2 Logical Mo Electric Motor C : 2 Logical Battery B : 2 Logical Mo 116.0 12700.0 690.0 0.66676190476190476190477 81 HybridGar_CAE Engine B : 2 Logical Mo Electric Motor C : 2 Logical Battery C : 2 Logical Mo 125.0 16000.0 650.0 0.746190476190477 82 HybridGar_ACA Engine A : 2 Logical Mo Electric Motor C : 2 Logical Battery B : 2 Logical Mo 125.0 16000.0 655.0 0.7245190476190477	74	HvbridCar CBC	Engine C : 2 Logical Mo Electric Motor B : 2 Log E Battery C : 2 Log	ical Mc 120.0	13900.0	690.0	0.7087619047619048
P6 HybridCar_EDE Engine E: 2 Logical Mo Electric Motor D: 2 Logi Battery E: 2 Logical Mo 1950.0 971.0 0.0 77 HybridCar_ADA Engine C: 2 Logical Mo Electric Motor A: 2 Logical Battery D: 2 Logical Mo 1500.0 690.0 0.6947619047619047 78 HybridCar_ADA Engine A: 2 Logical Mo Electric Motor C: 2 Logical Battery B: 2 Logical Mo 1500.0 620.0 0.6947619047617067 80 HybridCar_ACB Engine C: 2 Logical Mo Electric Motor A: 2 Logical Battery B: 2 Logical Mo 1500.0 650.0 0.74604761904771905 81 HybridCar_BCC Engine A: 2 Logical Mo Electric Motor A: 2 Logical Battery C: 2 Logical Mo 1500.0 650.0 0.72461904761904771 82 HybridCar_BCC Engine A: 2 Logical Mo Electric Motor C: 2 Logi Battery A: 2 Logical Mo 1500.0 650.0 0.7246190476190477 83 HybridCar_BCC Engine A: 2 Logical Mo Electric Motor C: 2 Logi Battery A: 2 Logical Mo 1500.0 650.0 0.7246190476190477 84 HybridCar_ACA	75	HybridCar_BDD	Engine B : 2 Logical Mo Electric Motor D : 2 Log Battery D : 2 Log	ical Mc150.0	15700.0	700.0	0.74533333333333334
77 HybridCar_CAD Engine C: 2 Logical Mo Electric Motor A: 2 Logical Mc 116.0 1300.0 690.0 0.6447619047619048 78 HybridCar_ADA Engine A: 2 Logical Mc Electric Motor D: 2 Logical Battery A: 2 Logical Mc 1180.0 15000.0 620.0 0.044285714285714 78 HybridCar_ACB Engine A: 2 Logical Mc Electric Motor A: 2 Logical Battery B: 2 Logical Mo 116.0 1200.0 590.0 0.74690476190476190476190478 80 HybridCar_ACB Engine C: 2 Logical Mo Electric Motor B: 2 Logical Battery B: 2 Logical Mo 116.0 12700.0 690.0 0.69676190476190478 81 HybridCar_ACC Engine C: 2 Logical Mo Electric Motor B: 2 Logical Battery C: 2 Logical Mo 114.0 13000.0 650.0 0.7246190476190477 82 HybridCar_ACA Engine C: 2 Logical Mo Electric Motor C: 2 Logical Battery A: 2 Logical Mo 125.0 16000.0 655.0 0.7245190476190477 83 HybridCar_AAB Engine A: 2 Logical Mo Electric Motor C: 2 Logical Battery B: 2 Logical Mo125.0 16000.0 655.0 0.7492380523309523 86 HybridCar_AAB Engine A: 2 Logical Mc Electric Motor C: 2 Logical Battery B: 2 Logicici Mo125.0 1	76	HybridCar_EDE	Engine E : 2 Logical Mo Electric Motor D : 2 Log Battery E : 2 Log	ical Mo 180.0	19500.0	971.0	0.0
78 HybridGar_ADA Engine A: 2 Logical Mc Electric Motor C: 2 Logical Battery B: 2 Logical Mc 138.0 HybridGar_ACB Engine A: 2 Logical Mc Electric Motor C: 2 Logical BMc Electric Motor C: 2 Logical Mc Electric Motor C: 2 Logical Battery C: 2 Logical Mc Electric Motor C: 2 Logical Battery C: 2 Logical Mc Electric Motor C: 2 Logical Battery C: 2 Logical Mc Electric Motor C: 2 Logical Battery A: 2 Logical Mc Electric Motor C: 2 Logical Battery A: 2 Logical Mc Electric Motor C: 2 Logical Battery A: 2 Logical Mc Electric Motor C: 2 Logical Battery A: 2 Logical Mc Electric Motor C: 2 Logical Battery A: 2 Logical Mc Electric Motor C: 2 Logical Battery A: 2 Logical Mc Electric Motor C: 2 Logical Battery A: 2 Logical Mc Electric Motor C: Logical Battery A: 2 Logical Mc Electric Motor C: Logical Battery A: 2 Logical Mc Electric Motor C: Logical	77	HybridCar_CAD	Engine C : 2 Logical Mo Electric Motor A : 2 Log Battery D : 2 Log	ical Mc116.0	13000.0	690.0	0.6947619047619048
P2 I HybridCar_ACB Engine A : 2 Logical Mc Electric Motor C : 2 Log Battry B : 2 Logical Mc 125.0 1420.0 590.0 0.7460476190476199 80 I HybridCar_ACB Engine C : 2 Logical Mc Electric Motor A : 2 Logica	78	HybridCar ADA	Engine A : 2 Logical Mg Electric Motor D : 2 Log Electric A : 2 Log	ical Mc138.0	15000.0	620.0	0.8014285714285714
80 I HybridCar_CAB Engine C : 2 Logical Mo Electric Motor A : 2 Log Battery B : 2 Logical Mo 116.0 1270.0 690.0 0.6967619047619048 81 I HybridCar_BCC Engine B : 2 Logical Mo Electric Motor C : 2 Logic	79	HybridCar_ACB	Engine A : 2 Logical Mc Electric Motor C : 2 Log Battery B : 2 Log	ical Mo 125.0	14200.0	590.0	0.746047619047619
81 HybridCar_BBC Engine B: 2 Logical Mo Electric Motor B: 2 Log Battery C: 2 Logical Mo 1500.0 650.0 0.6864761904761905 82 HybridCar_ACC Engine A: 2 Logical Mo Electric Motor C: 2 Log Battery C: 2 Logical Mo 115.0 16000.0 656.0 0.7245190476190477 83 HybridCar_ACA Engine C: 2 Logical Mo Electric Motor C: 2 Log Battery A: 2 Logical Mc13.0 14000.0 700.0 0.7933333333333 84 HybridCar_ACA Engine A: 2 Logical Mc Electric Motor C: 2 Log Battery A: 2 Logical Mc125.0 16000.0 655.0 0.6293809523809523 BybridCar_ACB Engine A: 2 Logical Mc Electric Motor C: 2 Log Battery B: 2 Logical Mo18.0 1500.0 656.0 0.7246190476190477 86 HybridCar_ACB Engine A: 2 Logical Mc Electric Motor 2: Logical Ma18.0 1500.0 656.0 0.7246190476190477 87 HybridCar	80	HybridCar_CAB	Engine C : 2 Logical Mo Electric Motor A : 2 Log Battery B : 2 Log	ical Mo 116.0	12700.0	690.0	0.6967619047619048
82 HybridGar_ACE Engine A: 2 Logical Mc Electric Motor C: 2 Logi Battery E: 2 Logical Mc Esolation 656.0 0.7246190476190477 83 HybridGar_ACA Engine C: 2 Logical Mc Electric Motor A: 2 Logical Mc Electric Motor C: 2 Logical Mc Motor Motor <td>81</td> <td>HybridCar BBC</td> <td>Engine B : 2 Logical Mo Electric Motor B : 2 Log Battery C : 2 Log</td> <td>ical Mc 114.0</td> <td>13600.0</td> <td>650.0</td> <td>0.6864761904761905</td>	81	HybridCar BBC	Engine B : 2 Logical Mo Electric Motor B : 2 Log Battery C : 2 Log	ical Mc 114.0	13600.0	650.0	0.6864761904761905
83 HybridCar_CAC Engine C : 2 Logical Mo Electric Motor A : 2 Logic Battery C : 2 Logical Mc 116.0 1290.0 679.0 Logical Mo 84 HybridCar_CAC Engine C : 2 Logical Mo Electric Motor C : 2 Logical Mo Electric Motor C : 2 Logical Mo Electric Motor C : 2 Logical Mo 85 HybridCar_ACA Engine A : 2 Logical Mo Electric Motor C : 2 Logical Mo Electric Motor C : 2 Logical Mo Electric Motor C : 2 Logical Mo 12 Logical Mo Electric Motor C : 2 Logical Mo 86 HybridCar_ACA Engine A : 2 Logical Mc Electric Motor C : 2 Logical Battery B : 2 Logical Mo Electric Motor C : 2 Logical Battery B : 2 Logical Mo Electric Motor C : 2 Logical Battery B : 2 Logical Mo 87 HybridCar_ACB Engine A : 2 Logical Mo Electric Motor C : 2 Logical Battery B : 2 Logical Mo Electric Motor C : 2 Logical Battery B : 2 Logical Mo 88 HybridCar_ACA Engine C : 2 Logical Mo Electric Motor D : 2 Logical Battery C : 2 Logical Mo Electric Motor D : 2 Logical Battery C : 2 Logical Mo Electric Motor P : 2 Logical Mo 91 HybridC	82	HybridCar_ACE	Engine A : 2 Logical Mc Electric Motor C : 2 Log Battery E : 2 Log	Ical Mo 125.0	16000.0	656.0	0.7246190476190477
84 HybridGar_BCA Engine B : 2 Logical Mo Electric Motor C : 2 Log Battery A : 2 Logical Mc (137.0) 1420.0 700.0 0.79033333333333 85 HybridGar_ACA Engine A : 2 Logical Mc Electric Motor C : 2 Log Battery A : 2 Logical Mc (125.0) 14000.0 605.0 0.742330952380953 86 HybridGar_ACA Engine A : 2 Logical Mc Electric Motor C : 2 Log Battery B : 2 Logical Mo (125.0) 16000.0 655.0 0.629380952380953 86 HybridGar_ADB Engine A : 2 Logical Mc Electric Motor C : 2 Log Battery B : 2 Logical Mo (125.0) 16000.0 655.0 0.629380952380952 87 HybridGar_ADB Engine A : 2 Logical Mc Electric Motor D : 2 Log Battery B : 2 Logical Mo (138.0) 15200.0 655.0 0.629280952380952 89 HybridGar_ADB Engine A : 2 Logical Mc Electric Motor D : 2 Log B Battery C : 2 Logical Mc (138.0) 15000.0 650.0 0.602741094761905 91 HybridGar_ADA Engine A : 2 Logical Mc Electric Motor D : 2 Log B Battery C : 2 Logical Mc (138.0) 15000.0 650.0 0.6027410947619047619 92	83	HybridCar_CAC	Engine C : 2 Logical Mo Electric Motor A : 2 Log E Battery C : 2 Log	ical Mc 116.0	12900.0	679.0	0.697
85 HybridGar_ACA Engine A: 2 Logical Mc Electric Motor C: 2 Log Battery A: 2 Logical Mc Electric Motor A: 2 Log HybridGar_ACB 605.0 Ox4523809523809533 86 HybridGar_ACB Engine A: 2 Logical Mc Electric Motor A: 2 Log Statery B: 2 Logical Mo Electric Motor A: 2 Log Statery B: 2 Logical Mo Electric Motor A: 2 Log Statery B: 2 Logical Mo Electric Motor A: 2 Log Statery C: 2 Log Alg Statery C: 2 Log Alg Alg Statery C: 2 Log Alg	84	HybridCar BCA	Engine B : 2 Logical Mo Electric Motor C : 2 Log E Battery A : 2 Log	ical Mc137.0	14200.0	700.0	0.790333333333333333
86 HybridCar_AAB Engine A : 2 Logical Mc Electric Motor A : 2 Logical Mc Battery B : 2 Logical Mc 1220.0 555.0 0.6293809523809523 87 HybridCar_ACB Engine A : 2 Logical Mc Electric Motor C : 2 Logical Battery E : 2 Logical Mc 125.0 16000.0 656.0 0.7246190476190477 88 HybridCar_ACB Engine A : 2 Logical Mc Electric Motor C : 2 Logical Battery E : 2 Logical Mc 115.0 15200.0 655.0 0.7246190476190477 89 HybridCar_ACD Engine C : 2 Logical Mc Electric Motor D : 2 Logical Battery E : 2 Logical Mc 116.0 12900.0 679.0 0.6977 90 HybridCar_ACD Engine A : 2 Logical Mc Electric Motor D : 2 Logical Battery C : 2 Logical Mc 118.0 15000.0 640.0 0.724761904761905 91 HybridCar_ACA Engine A : 2 Logical Mc Electric Motor D : 2 Logical Battery C : 2 Logical Mc 118.0 15000.0 640.0 0.761904761904761905 92 HybridCar_ADA Engine A : 2 Logical Mc Electric Motor A : 2 Logical Battery D : 2 Logical Mc 118.0 15000.0 650.0 0.69761904761904761904 92 HybridCar_ADA Engine A : 2 Logical Mc Electric Motor A : 2	85	HybridCar_ACA	Engine A : 2 Logical Mc Electric Motor C : 2 Log Battery A : 2 Log	ical Mc125.0	14000.0	605.0	0.7452380952380953
87 I HybridGar_ACE E Engine A : 2 Logical Mc E Electric Motor D : 2 Logi Battery E : 2 Logical Mo 125.00 656.0 0.7246190476190477 88 I HybridGar_ADB E Engine A : 2 Logical Mc Electric Motor D : 2 Log Battery B : 2 Logical Mo 15200.0 655.0 0.802238052380552 89 I HybridGar_ADB Engine A : 2 Logical Mc Electric Motor D : 2 Log Battery B : 2 Logical Mo 15200.0 679.0 0.697 91 I HybridGar_ADC Engine A : 2 Logical Mc Electric Motor D : 2 Log Battery C : 2 Logical Mc 15400.0 594.0 0.8024761904761904761904761905 91 I HybridGar_ADA Engine A : 2 Logical Mc Electric Motor D : 2 Log Battery A : 2 Logical Mc18.0 15000.0 640.0 0.761904721	86	HybridCar AAB	Engine A : 2 Logical Mc Electric Motor A : 2 Log Battery B : 2 Log	ical Mo 98.0	12200.0	555.0	0.6293809523809523
88 I HybridGar_ADB E Engine A : 2 Logical Mc Electric Motor D : 2 Log Battery B : 2 Logical Mc 138.0 1520.0 605.0 0.8022380952380952 89 I HybridGar_ACC E Engine C : 2 Logical Mc Electric Motor A : 2 Log Battery C : 2 Logical Mc 138.0 15200.0 679.0 0.897 90 I HybridGar_ACC E Engine A : 2 Logical Mc Electric Motor A : 2 Log Battery C : 2 Logical Mc 138.0 15000.0 679.0 0.8024761997619976199761997619976199761997619	87	E HybridCar ACE	Engine A : 2 Logical Mc Electric Motor C : 2 Log E Battery E : 2 Log	ical Mo 125.0	16000.0	656.0	0.7246190476190477
89 I HybridCar_CAC Engine C : 2 Logical Mo Electric Motor A : 2 Log Battery C : 2 Logical Mo (116.0) 1290.0 679.0 0.697 90 I HybridCar_ADC Engine A : 2 Logical Mo Electric Motor D : 2 Logical Battery C : 2 Logical Mo (118.0) 15400.0 594.0 0.80276190476190476199 91 I HybridCar_ADA Engine A : 2 Logical Mo Electric Motor D : 2 Logical Battery X : 2 Logical Mo (118.0) 15400.0 640.0 0.802476190476199 92 I HybridCar_ADA Engine A : 2 Logical Mo Electric Motor D : 2 Logical Battery A : 2 Logical Mo (118.0) 15000.0 640.0 0.8014285714285714 92 I HybridCar_ADA Engine C : 2 Logical Mo Electric Motor A : 2 Logical Battery B : 2 Logical Mo (118.0) 12000.0 690.0 0.8007461904761904761904 92 I HybridCar_ADA Engine C : 2 Logical Mo Electric Motor A : 2 Logical Battery B : 2 Logical Mo (118.0) 12000.0 690.0 0.8002380952380952 94 HybridCar_HDD Engine H : 2 Logical Mo Electric Motor B : 2 Logical Battery C : 2 Logical Mo (118.0) 1700.0 0.0 95 HybridCar_ADB Engine H : 2 Logical Mo Electric Motor B : 2 Logical Bat	88	HybridCar_ADB	Engine A : 2 Logical Mc Electric Motor D : 2 Log E Battery B : 2 Log	ical Mo 138.0	15200.0	605.0	0.8022380952380952
90 HybridCar_ADC Engine A: 2 Logical Mc Electric Motor D: 2 Log Battery C: 2 Logical Mc 138.0 15400.0 594.0 0.8024761904761905 91 HybridCar_ADA Engine A: 2 Logical Mc Electric Motor E: 2 Log Battery A: 2 Logical Mc 138.0 16000.0 640.0 0.761904761904761904761904 92 HybridCar_ADA Engine A: 2 Logical Mc Electric Motor E: 2 Log Battery A: 2 Logical Mc 138.0 15000.0 620.0 0.8014285714285714 93 HybridCar_ADA Engine A: 2 Logical Mc Electric Motor A: Log Battery A: 2 Logical Mc 138.0 15000.0 620.0 0.80947619047619048 94 HybridCar_ADA Engine A: 2 Logical Mc Electric Motor P: 2 Log Battery D: 2 Logical Mc 138.0 15000.0 650.0 0.809280952380952 94 HybridCar_HED Engine A: 2 Logical Mc Electric Motor D: 2 Log Battery D: 2 Logical Mc 138.0 15000.0 650.0 0.802380952380952 96 HybridCar_HED Engine A: 2 Logical MC Electric Motor D: 2 Log Battery D: 2 Logical Mc 138.0 15000.0 605.0 0.802380952380952 97 HybridCar_HEC	89	HybridCar CAC	Engine C : 2 Logical Mo Electric Motor A : 2 Log Battery C : 2 Log	ical Mc 116.0	12900.0	679.0	0.697
91 HybridCar_AEA Engine A : 2 Logical Mc Electric Motor E : 2 Logical Mc 184.0 16000.0 640.0 0.7619047619047619 92 HybridCar_ADA Engine A : 2 Logical Mc Electric Motor D : 2 Logical Battery A : 2 Logical Mc 184.0 15000.0 620.0 0.8014285714285714 93 HybridCar_ADA Engine A : 2 Logical Mc Electric Motor D : 2 Logical Battery B : 2 Logical Mc 116.0 12700.0 690.0 0.6967619047619048 94 HybridCar_ADA Engine A : 2 Logical Mc = Electric Motor D : 2 Logical Mc 116.0 12700.0 1070.0 0.46967619047619048 95 HybridCar_ADD Engine A : 2 Logical Mc = Electric Motor D : 2 Logical Mc 186.0 20500.0 1070.0 0.0 96 HybridCar_ADD Engine A : 2 Logical Mc = Electric Motor B : 2 Logical Mc 186.0 15000.0 605.0 0.802380952380952 96 HybridCar_ADB Engine A : 2 Logical Mc = Electric Motor B : 2 Logical Mc 120.0 1740.0 1000.0 0.0 97 HybridCar_ADB Engine A : 2 Logical Mc = Electric Motor B : 2 Logical Mc 184.0 2500.0 1112.0 0.0 98 HybridCar_ADB Engine A : 2 Logical Mc = Electric Motor B : 2	90	HybridCar ADC	Engine A : 2 Logical Mc Electric Motor D : 2 Log E Battery C : 2 Log	ical Mc 138.0	15400.0	594.0	0.8024761904761905
92 HybridCar_ADA Engine A: 2 Logical Mc Electric Motor D: 2 Logical Mc138.0 1500.0 620.0 0.8014285714285714 93 HybridCar_ADB Engine A: 2 Logical Mc Electric Motor D: 2 Logical Mc138.0 1500.0 620.0 0.900.0 0.990.0 1.91/9/10/CarDB2 <p< td=""><td>91</td><td>HvbridCar_AEA</td><td>Engine A : 2 Logical Mc Electric Motor E : 2 Log Electric A : 2 Log</td><td>ical Mc 148.0</td><td>16000.0</td><td>640.0</td><td>0.7619047619047619</td></p<>	91	HvbridCar_AEA	Engine A : 2 Logical Mc Electric Motor E : 2 Log Electric A : 2 Log	ical Mc 148.0	16000.0	640.0	0.7619047619047619
93 HybridCar_CAB Engine C: 2 Logical Mo Electric Motor A: 2 Logi Battery B: 2 Logical Mo 116.0 12700.0 690.0 0.6967619047619048 94 HybridCar_HDD Engine H: 2 Logical Mo Electric Motor F: 2 Logical Mo Electric Motor F: 2 Logical Mo 166.0 20500.0 1070.0 0.0 95 HybridCar_HDD Engine H: 2 Logical Mo Electric Motor D: 2 Logical Mo 166.0 20500.0 1070.0 0.8002380952380952 96 HybridCar_HBC Engine H: 2 Logical Mo Electric Motor B: 2 Logical Mo 12 Logical Mo 17400.0 1000.0 0.0 97 HybridCar_JBE Engine A: 2 Logical Mo Electric Motor B: 2 Logical Mo 12 Logical Mo 12 Logical Mo 12 Logical Mo 0.0 97 HybridCar_JBE Engine A: 2 Logical Mo Electric Motor B: 2 Logical Mo 12 Logical Mo 138.0 15200.0 605.0 0.022380952380952 98 HybridCar_JDE Engine A: 2 Logical Mo Electric Motor B: 2 Logical Mo 184.0 2500.0 1112.0 0.0 90 HybridCar_JDE Engine A: 2 Logical Mo	92	HvbridCar ADA	Engine A : 2 Logical Mc Electric Motor D : 2 Log E Battery A : 2 Log	ical Mc138.0	15000.0	620.0	0.8014285714285714
94 HybridCar_HED E Engine H : 2 Logical Mc E Electric Motor E : 2 Logi Battery D : 2 Logical Mc 166.0 2050.0 1070.0 0.0 95 HybridCar_LDD E Engine A : 2 Logical Mc E Electric Motor D : 2 Logical Mc 184.0 15500.0 605.0 0.002380952380952 96 HybridCar_LDD E Engine A : 2 Logical Mc Electric Motor D : 2 Logical Mc 184.0 15500.0 1000.0 0.0 97 HybridCar_LDB E Engine A : 2 Logical Mc Electric Motor D : 2 Logical Mc 184.0 20500.0 1112.0 0.0 98 HybridCar_LDB E Engine A : 2 Logical Mc Electric Motor D : 2 Logical Mc 184.0 20500.0 1112.0 0.0 99 HybridCar_LDB E Engine A : 2 Logical Mo = Electric Motor B : 2 Logical Mo 184.0 25500.0 1112.0 0.0 99 HybridCar_LDB E Engine A : 2 Logical Mo = Electric Motor B : 2 Logical Mo 184.0 25500.0 1112.0 0.0 90 HybridCar_LDB E Engine A : 2 Logical Mo = Electric Motor B : 2 Logical Mo 184.0 25500.0 1112.0 0.0 90 HybridCar_LDB E Engine A : 2 Logical Mo = Electric Motor B : 2 Logical Mo 1	93	HybridCar_CAB	Engine C : 2 Logical Mo Electric Motor A : 2 Log Battery B : 2 Log	ical Mo 116.0	12700.0	690.0	0.6967619047619048
95 HybridCar_ADD Engine A: 2 Logical Mc Electric Motor D: 2 Log Battery D: 2 Logical Mc 138.0 15500.0 605.0 0.8002380952380952 96 HybridCar_HBC Engine H: 2 Logical Mc Electric Motor B: 2 Log Battery D: 2 Logical Mc 120.0 17400.0 1000.0 0.0 97 HybridCar_JBE Engine H: 2 Logical Mc Electric Motor B: 2 Log Battery D: 2 Logical Mc 120.0 17400.0 1000.0 0.0 98 HybridCar_JBE Engine A: 2 Logical Mc Electric Motor B: 2 Log Battery D: 2 Logical Mo 144.0 20500.0 1112.0 0.0 90 HybridCar_JBE Engine J: 2 Logical Mc Electric Motor B: 2 Log Battery E: 2 Logical Mo 144.0 20500.0 1112.0 0.0 90 HybridCar_JBE Engine J: 2 Logical Mc Electric Motor B: 2 Log Battery E: 2 Logical Mo 144.0 20500.0 1112.0 0.0 91 HybridCar_JBE Engine J: 2 Logical Mc Electric Motor B: 2 Log Battery E: 2 Logical Mo 138.0 15200.0 605.0 0.8022380952380952 92 HybridCar_JBE Engine J: 2 Logical Mc Electric Motor B: 2 Log	94	HybridCar_HED	Engine H : 2 Logical Mc Electric Motor E : 2 Log E Battery D : 2 Loc	ical Mc166.0	20500.0	1070.0	0.0
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97 HybridCar_JBE Engine J : 2 Logical Mo Electric Motor B : 2 Log Battery E : 2 Logical Mo 144.0 20500.0 1112.0 0.0 98 HybridCar_ADB Engine A : 2 Logical Mo Electric Motor D : 2 Log Battery E : 2 Logical Mo 138.0 15200.0 605.0 0.022380952380952 99 HybridCar_ADB Engine J : 2 Logical Mo Electric Motor D : 2 Log Battery E : 2 Logical Mo144.0 20500.0 1112.0 0.0 100 HybridCar_ADB Engine J : 2 Logical Mo Electric Motor B : 2 Logical Mo144.0 20500.0 1112.0 0.0	96	HybridCar HBC	Engine H : 2 Logical Mc Electric Motor B : 2 Log Electric C : 2 Log	ical Mc 120.0	17400.0	1000.0	0.0
98 HybridCar_ADB Engine A: 2 Logical Mc Electric Motor D: 2 Log Battery B: 2 Logical Mo138.0 15200.0 605.0 0.8022380952380952 99 HybridCar_JBE Engine J: 2 Logical Mo Electric Motor D: 2 Log Battery B: 2 Logical Mo148.0 15200.0 605.0 0.8022380952380952 90 HybridCar_JBE Engine J: 2 Logical Mo Electric Motor D: 2 Log Battery B: 2 Logical Mo148.0 20500.0 1112.0 0.0 100 HybridCar_ADB Engine A: 2 Logical Mo Electric Motor D: 2 Log Battery B: 2 Logical Mo138.0 15200.0 605.0 0.8022380952380952	97	HybridCar_JBE	Engine J : 2 Logical Mo Electric Motor B : 2 Log E Battery E : 2 Log	ical Mo 144.0	20500.0	1112.0	0.0
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100 E HybridCar_ADB Engine A : 2 Logical Mc E Electric Motor D : 2 Logi E Battery B : 2 Logical Mo138.0 15200.0 605.0 0.8022380952380952	99	HybridCar_JBE	Engine J : 2 Logical Mo Electric Motor B : 2 Log Battery E : 2 Log	ical Mo 144.0	20500.0	1112.0	0.0
	100	HybridCar_ADB	Engine A : 2 Logical Mc Electric Motor D : 2 Log Battery B : 2 Log	ical Mo138.0	15200.0	605.0	0.8022380952380952

Figure A4 Experimental Results of the Roulette-Wheel Selector Part 2

Authors' Profiles



Ho Kit Robert Ong (Graduate Student) Address: Assumption University 592/3 Soi 24 Ramkhamhaeng Road, Hua Mak Bangkok, 10240, Thailand Tel: +66831129138 Email: robert ong@me.com

Ho Kit Robert Ong started as a Borland C++Builder 6 product certified trainer and consultant for Borland Together and CaliberRM. He joined No Magic, Inc. a standardsdriven software provider of model-driven enterprise solutions based on the Object Management Group (OMG) standards as a Senior Analyst and was promoted as a Director of Product Development, assuring client requirements were delivered by improving features and capabilities of the tools to meet the needs. Having been in the position for years, he challenged himself to take on new responsibilities as a Director of Business Development. With his 16+ years of experience in working with clients in a fast-moving environment, Robert accumulates strengths in the MBSE/MBRE, project management, requirements engineering, IT solutions finding, domain, and business process analysis, business process re-engineering, and Enterprise Architecture.



Dr. Thotsapon Sortrakul (Assistant Professor) Address: School of Science and Technology, Assumption University, 592/3 Soi 24 Ramkhamhaeng Road, Hua Mak Bangkok, 10240, Thailand Tel: +66818286111 Email: thotsapon@scitech.au.edu

Dr. Thotsapon Sortrakul received a 4-year research grant for the Target Recognition Projects from the U.S. Department of Defense (DoD) during his master's and PhD studies in Electrical Engineering at Southern Illinois University. He was Associate Dean for Post Graduate Studies of the Faculty of Computer Information Systems at Assumption University in 1999. An ICT committee and a member of the Board, he worked with over 40

government and private industries on ICT and engineering projects and authored more than 40 publications. He is now an Advisory Consultant in several Engineering and System Development firms and an Associate Judge of the Intellectual Property and International Trade Court. He received the Robotics and Artificial Intelligent System research funding from the Royal Thai Army Research and Development Office. His current research work focuses on the areas of Robotics, Data Analytics, Machine Intelligence, and Image Processing.