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Shipping and Transport Optimization on Vehicle Routing Problem (VRP) with Genetic Algorithm

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Abstract
Transport was one of the important issues that are owned by the logistics department, so that transport costs should be as efficient as possible because it can contribute more in order to reduce the total cost and to improve the company's competitive advantage. This research aims to generate a distribution service that has the shortest total mileage of limitations of the capacity of the vehicles, so that the distribution of the goods shall not exceed the limit of vehicles owned. Capacitated Vehicle Routing Problem (CVRP) was one of the problems with using a mathematical model based on considerations of distance and capacity of the vehicle in order to obtain the solution of this problem, use genetic algorithm (GA). GA chosen because it has the advantages of other methods, this genetic algorithm proposed has much quicker convergence speed, stronger overcoming getting into partial optimal ability. Therefore, it was more practical significance and value so as to reduce operating cost and improve economic benefit. As a support of basic goods distribution system, the system will be creating applications that integrate with the delivery process is used to determine which OOAD methods and system design requirements in accordance with company requirements. This system will be used as a tool to support the company's performance and speed up the process of making the distribution of goods.
Keywords: VRP, Genetic Algorithm, Transportation, OOAD.

INTRODUCTION

The number of competition as well as high customer requirements encourage companies to undertake various improvements in distribution and transport activities. Problems of distribution and transport became important because of the magnitude of the costs that must be incurred to the distribution activities in logistics management. The company realized that the problems that can lead to suboptimal transportation is caused by varying the number of requests for each customer, the limitations of the vehicle, the deadline for delivery, the location of customers, demand for the berfluktuatif and how to create a route with the aim to manage the sum of total distance thus reducing transportation costs.

By knowing the route and schedule of delivery vehicles is right, it will reduce the problems that are found in the logistics. These problems can be described as the problem of Vehicle Routing Problem (VRP) in which case delivery delays due to fault distribution routes. This is a problem of Vehicle Routing Problem (VRP). VRP aims to find the most optimal routes for distribution of goods from one depot to customers that it is spread out and back to the depot must pay attention to the terms of capacity owned by vehicle(Ong & Suprayogi, 2011).

This VRP problem can be solved by many methods, one of which with a Genetic Algorithm (GA). GA is a method used to solve a problem of value in search optimization. This algorithm is based on the genetic processes in living organisms by mimicking biological evolutionary theory (Bräysy, 2001).

The GA method was chosen because it has the advantage of other methods, such as the GA process, which offers a more stable speed as time goes by and more powerful abilities in the face of an optimum ability. Then GA is more valuable and practical in a significant way to reduce operating costs and improve value advantage (REN, 2012).

Harm in choosing a route distribution resulting in delays in the delivery of the goods. This makes the company issued a lower operational cost. In addition the company often have problems in terms of lack of vehicles, due to the large number of customer requests that appear every day. If the issue is not resolved, sooner or later the company suffered heavy losses.

Frisian Flag Industry (FFI) has been already running its business activities with a system that has been integrated properly, thus allowing the FFI to minimize errors that occur. But in terms of the distribution of goods, the determination of the route and the shortest distance determination still use the manual way. In terms of distribution routes search companies always use separate orders per areas such as East, South Jakarta and Bekasi, Indonesian. After that divide the vehicle according to its area by looking at the number of orders and capacity of vehicle.

The determination of the route of this distribution is done manually spend quite a long time usually spent less than 30 minutes to one hour. Therefore, it will be designed application programs that can perform the search quicker distribution route, so it will be able to save time and costs and to improve the service to customers. The making of the program by using the method of GA, taking into account the distance from the depot to the distance between the customer and the customers as well as the number of vehicles used and the capacity of the vehicle is.

The shortest route search without a computer program is just a useless box. The utilization of information technology in the shortest path search results in a precise and accurate results. So the existence of this goods distribution route program, is expected to be more developed FFI longer and provide better service to its customers (Mutakhiroh, Saptono, & Wiryadinata, 2007).

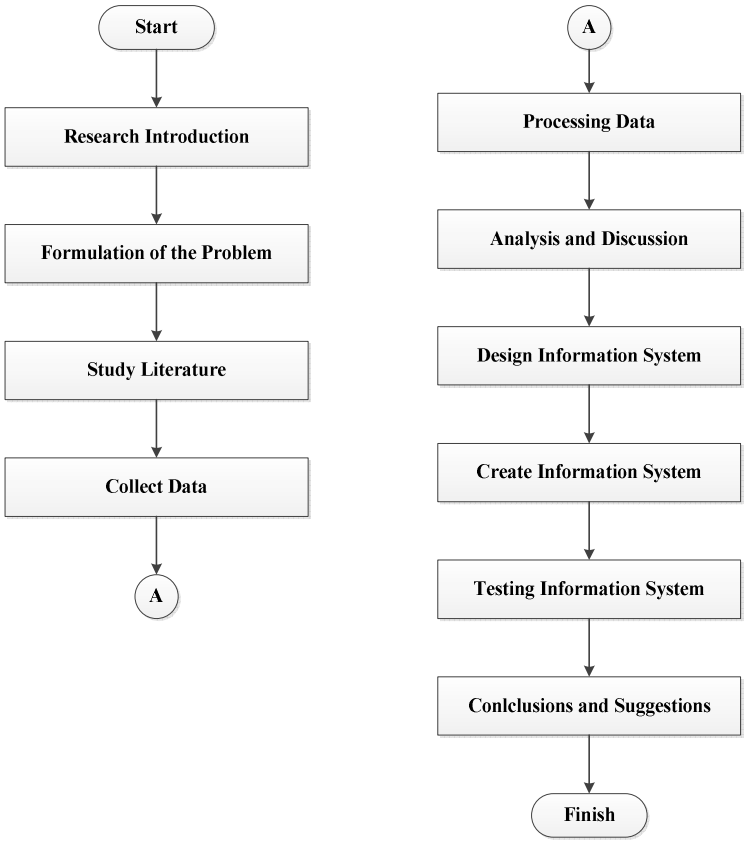
Therefore, optimizing the selection of route and the shortest distance in the delivery of the goods distributing and designing information systems are organized to do to optimize the distribution of shipments carried out by FFI.

RESEARCH METHODS

In doing this research is described about the process and the sequence of work. The following is the process of workmanship:

1. **Research Introduction**
   Preliminary research conducted in Frisian Flag Industry (FFI) is to do a factory to the overall observation and study the picture of General Mills. A preliminary study of will know through all the business processes running on FFI. Besides direct observation, done all the interviews of employees of FFI. Preliminary research undertaken aims to facilitate identification of problems at later stages.
2. **Formulation of the Problem**
   After doing the direct observation and interviews, it will be found a couple of problems encountered by the FFI. The problems were found to be elevated to an identification of the problems to be solved in this study. Of problems that are found, there are limitations on the issue would be the scope of the research. From the formulation of the problem and scope are made, it is hoped the goal of this research can be achieved and also useful for researchers, readers as well as the company itself.
3. **Study Literature**
   After that, researchers will look for information as well as supporting theories regarding the issue case studies conducted. The library studies done using books as literature, scientific journals and information from the internet. The Library conducted a study expected to be a cornerstone of the theory to solve existing problems in the FFI.
4. **Collect Data**
   Data collection can be obtained by researchers directly and indirectly. Data acquired directly by researchers by observation and survey to the company. Data obtained indirectly may include records of reports contained in the archive. As for the data that is required by the researchers is the company profile, business processes within the enterprise, consumer data, request data, the data used and the vehicle operating costs incurred by the company.
5. **Processing Data**
   From the data we've collected, the next step is to do the processing of such data will be. Data processing is carried out using the method of genetic algorithms (GA) consisting of 5 stages, namely:
   a. Initial Population
      At this stage is the process of generating a number of individuals at random or through certain procedures. The conditions that must be met to demonstrate a solution should really look for in each individual generation.
   b. Fitness Evaluation
      First of all looking for a fitness value will be made in achieving optimal value reference in the genetic algorithm. The fitness value is a value that declares whether or not a solution (individual).
   c. Individual Selection
      The selection is done to get a candidate a good parent, "a good parent will produce good offspring." The higher the value of an individual fitness then ever more likely to be elected. The selection can be done using random.
   d. Crossover and Mutation
      After making the selection of the individual, the next step is to do a crossover and mutation. The Crossover is the process of combining two individuals to acquire new individuals expected to have better fitness. Not all carrier couples undergoing the process of crossover, large mains couples who have experienced crossover probability value specified with crossover.
      Gene mutation is a process of replacing genes. This process is done randomly on the position of a particular gene on the individuals selected for the transfers. The number of individuals who have experienced mutation determined by the magnitude of the probability of mutations.
   e. New Population
      After performing the stages it will obtain new population. Of this new population will be repeated again from the stage 2 and so on until it finds the most optimal results.

6. **Analysis and Discussion**
   After making a further data processing researchers perform analysis of data already in the sport. Analysis of alternative route selection and the selection of goods distribution alternative routes are given. The purpose of this analysis is to provide a summary of the problems raised and can provide advice to companies.
7. **Design Information System**
   After doing the analysis data processing and analysis, then the obtained data structures that were later incorporated into the system to be created. The system is designed referring to data processing and analysis of the needs of the user. The system was designed based on business processes, related actors, the event that occurred and the activities carried out in the system.
8. **Create Information System**
   This step is doing the creation of information systems in the form of applications that are based on the design of information systems, ranging from the problem domain analysis and realization of component design. Expected with the creation of this program, the company's distribution system will run better.
9. **Testing Information System**
   This information system testing done to see if there is still a lot of errors or bugs, if there is still a lot of error it will be re-examined until there are no more errors or bugs. As well as whether the program has been made in accordance with the needs of the user.
10. **Conclusions and Suggestions**
    After doing this step, it will all be withdrawn a summary of existing problems. A summary of the created is expected to give an answer of the research objectives, and then later a suggestion be given are useful and beneficial for a company to increase competition. This contains a summary of the results of such research. Based on the results of the research will be obtained the advice useful to the progress of the company and to improve the quality of service.
    Here is a picture of research flowchart:



Picture 1. Research Flowchart

STEP BY STEP GENETIC ALGORITHM

1. Initial Population

This step aims to generate an initial population contains a number of chromosomes that have been determined as much. For example the number of chromosomes in the initial populations have been determined as many as 30 chromosomes, chromosomes that form looks like on a table 1. The initial population is chosen at random, based on random values that appear. On this initial population phase are all individuals in the population before the iteration starts.

Table 1. Initial Population

Kromosom	Populasi Awal																	
1	4	8	12	13	20	1	10	3	2	5	11	17	9	19	6	18	14	16	15	7
2	11	4	18	19	17	15	8	13	10	12	20	2	6	14	3	16	5	7	1	9
3	1	16	10	18	19	4	8	6	3	12	15	20	13	7	11	14	5	2	17	9
4	8	15	6	9	3	14	5	17	2	1	20	7	18	13	10	16	4	12	19	11
5	17	9	15	19	14	1	20	10	2	3	13	11	8	19	4	6	12	7	5	16
6	13	17	5	6	1	12	14	16	3	11	7	2	19	9	18	10	20	4	8	15
7	15	20	2	11	9	13	7	19	8	12	10	1	14	16	5	3	6	18	4	17
8	12	1	15	10	17	13	8	20	14	18	9	16	5	4	3	7	11	19	2	6
9	4	19	8	13	14	3	9	5	2	17	12	6	18	7	10	20	11	16	1	15
10	4	2	17	15	6	5	11	14	12	16	7	9	8	10	1	18	20	13	19	3
11	4	8	1	11	2	3	17	13	16	20	7	15	10	6	12	14	19	5	18	9
12	14	8	16	6	2	15	12	3	5	19	18	9	1	10	20	4	7	11	17	13
13	19	14	6	13	8	20	4	10	16	17	1	12	11	5	18	9	15	2	3	7
14	6	4	19	17	7	14	12	15	8	13	18	3	5	10	9	2	20	11	16	1
15	7	8	19	11	5	2	3	20	1	4	17	15	18	9	10	13	12	16	6	14
16	7	4	2	13	10	6	12	15	11	16	9	5	17	3	8	14	19	20	18	1
17	8	3	4	10	13	14	12	18	5	9	19	6	17	7	2	1	16	15	20	11
18	10	14	5	20	15	6	4	13	1	9	18	16	12	7	3	19	17	8	11	2
19	2	12	9	14	5	1	20	3	6	16	10	18	11	15	13	7	17	19	8	4
20	20	19	18	4	7	2	13	12	6	9	8	17	5	3	1	10	11	14	15	16
21	15	10	2	20	7	8	13	5	16	3	12	17	1	11	14	19	18	4	6	9
22	6	13	18	4	5	20	12	17	7	1	16	19	10	11	9	2	15	8	14	3
23	8	9	3	6	4	14	12	13	1	17	5	18	19	20	2	16	7	11	15	10
24	15	8	7	5	19	4	3	1	9	13	18	2	16	10	20	12	14	17	6	11
25	20	16	7	4	15	3	1	9	12	5	2	18	19	10	17	11	6	8	14	13
26	17	9	7	10	16	11	20	1	12	14	13	3	2	8	19	18	15	6	5	4
27	6	20	13	4	5	12	3	16	15	11	9	14	19	8	2	1	10	17	18	7
28	15	11	1	13	19	20	16	4	18	5	7	3	9	2	10	14	8	17	6	12
29	18	11	17	5	7	14	6	13	8	3	1	2	12	9	10	15	20	19	4	16
30	4	7	9	18	10	15	1	20	14	5	8	11	12	6	2	3	19	13	16	17

2. Evaluate Fitness Function

The fitness function is used to determine how well the individuals produced by each of the chromosomes. Total distance is the distance between a number of routes by other routes. The higher the value the fitness of a chromosome, it will be the better value of the chromosome. To find the value of fitness is as follows:

$$\text{Fitness function} = \frac{1}{412.6} = 0.00242$$

It will be the fitness value of results obtained every chromosome, as follows:

Table 2. Fitness Function

Kromosom	Total Jarak	Fitness
1	412.6	0.00242
2	331.9	0.00301
3	392.1	0.00255
4	428.3	0.00233
5	422.4	0.00237
6	394.5	0.00253
7	341.7	0.00293
8	450.3	0.00222
9	365.2	0.00274
10	325.2	0.00308
11	385.7	0.00259
12	418.9	0.00239
13	416.6	0.00240
14	404.8	0.00247
15	512.0	0.00195

Kromosom	Total Jarak	Fitness
16	383.4	0.00261
17	409.5	0.00244
18	360.6	0.00277
19	357.9	0.00279
20	415.9	0.00240
21	429.6	0.00233
22	442.4	0.00226
23	454.2	0.00220
24	394.5	0.00253
25	382.2	0.00262
26	401.5	0.00249
27	389.4	0.00257
28	379.9	0.00263
29	420.7	0.00238
30	460.6	0.00217
Total	12084.5	0.07519

3. Selection

The next step is to select the results of the population. Before making this selection, first of all is to find the probability of the fitness of each route and find the cumulative probability of each route. Probability of fitness obtained by first summing the entire value of the existing fitness after that values each individual's fitness for a total value of fitness.

Table 3. The results of selection of each Chromosome

Kromosom																			Fitness	Ke-
6	13	18	4	5	20	12	17	7	1	16	19	10	11	9	2	15	8	14	3	0.00226	22
6	4	19	17	7	14	12	15	8	13	18	3	5	10	9	2	20	11	16	1	0.00247	14
8	15	6	9	3	14	5	17	2	1	20	7	18	13	10	16	4	12	19	11	0.00233	4
15	20	2	11	9	13	7	19	8	12	10	1	14	16	5	3	6	18	4	17	0.00293	7
4	8	1	11	2	3	17	13	16	20	7	15	10	6	12	14	19	5	18	9	0.00259	11
18	11	17	5	7	14	6	13	8	3	1	2	12	9	10	15	20	19	4	16	0.00238	29
7	8	19	11	5	2	3	20	1	4	17	15	18	9	10	13	12	16	6	14	0.00195	15
8	9	3	6	4	14	12	13	1	17	5	18	19	20	2	16	7	11	15	10	0.00220	23
4	8	12	13	20	1	10	3	2	5	11	17	9	19	6	18	14	16	15	7	0.00242	1
17	9	15	19	14	1	20	10	2	3	13	11	8	19	4	6	12	7	5	16	0.00237	5
11	4	18	19	17	15	8	13	10	12	20	2	6	14	3	16	5	7	1	9	0.00301	2
2	12	9	14	5	1	20	3	6	16	10	18	11	15	13	7	17	19	8	4	0.00279	19
14	8	16	6	2	15	12	3	5	19	18	9	1	10	20	4	7	11	17	13	0.00239	12
10	14	5	20	15	6	4	13	1	9	18	16	12	7	3	19	17	8	11	2	0.00277	18
8	15	6	9	3	14	5	17	2	1	20	7	18	13	10	16	4	12	19	11	0.00233	4
7	4	2	13	10	6	12	15	11	16	9	5	17	3	8	14	19	20	18	1	0.00261	16
4	8	1	11	2	3	17	13	16	20	7	15	10	6	12	14	19	5	18	9	0.00259	11
4	7	9	18	10	15	1	20	14	5	8	11	12	6	2	3	19	13	16	17	0.00217	30
11	4	18	19	17	15	8	13	10	12	20	2	6	14	3	16	5	7	1	9	0.00301	2
8	9	3	6	4	14	12	13	1	17	5	18	19	20	2	16	7	11	15	10	0.00220	23
11	4	18	19	17	15	8	13	10	12	20	2	6	14	3	16	5	7	1	9	0.00301	2
7	4	2	13	10	6	12	15	11	16	9	5	17	3	8	14	19	20	18	1	0.00261	16
4	8	1	11	2	3	17	13	16	20	7	15	10	6	12	14	19	5	18	9	0.00259	11
14	8	16	6	2	15	12	3	5	19	18	9	1	10	20	4	7	11	17	13	0.00239	12
1	16	10	18	19	4	8	6	3	12	15	20	13	7	11	14	5	2	17	9	0.00255	3
20	19	18	4	7	2	13	12	6	9	8	17	5	3	1	10	11	14	15	16	0.00240	20
8	3	4	10	13	14	12	18	5	9	19	6	17	7	2	1	16	15	20	11	0.00244	17
17	9	7	10	16	11	20	1	12	14	13	3	2	8	19	18	15	6	5	4	0.00249	26
6	4	19	17	7	14	12	15	8	13	18	3	5	10	9	2	20	11	16	1	0.00247	14
15	10	2	20	7	8	13	5	16	3	12	17	1	11	14	19	18	4	6	9	0.00233	21

4. Crossover

Crossover is a process crosses a pair of chromosome parents to produce offspring or descendants who became the next generation. Offspring resulting from this crossover process is expected to have superior properties owned by their parents. Determining the crossover done by comparing the value of the probability of crossover (pc) with the numbers generated by random.

The method used to make the crossover is in methods of multi-point crossover, namely the length of the chromosomes are selected for random and are not allowed to have the same position, variables exchanged between chromosomes at that point to produce offspring/children who are better than her parents (parent), as Table 4.

Table 4. The result of the Crossover

	Kromosom																				Fitness
Anak 1	4	8	12	19	14	1	20	10	2	3	13	11	9	17	15	6	18	7	5	16	0.00236
Anak 2	17	9	15	13	20	1	10	3	2	5	11	12	8	19	6	18	14	16	4	7	0.00207
	Kromosom																				Fitness
Anak 3	4	2	17	15	6	14	12	3	5	19	18	9	1	10	20	8	7	11	16	13	0.00239
Anak 4	14	8	16	6	2	5	11	15	12	17	7	9	4	10	1	18	20	13	19	3	0.00249
	Kromosom																				Fitness
Anak 5	2	12	18	4	7	20	13	19	6	9	8	17	5	3	1	10	11	14	15	16	0.00221
Anak 6	20	19	9	14	5	1	2	3	6	16	10	18	11	15	13	7	17	12	8	4	0.00312
	Kromosom																				Fitness
Anak 7	15	10	2	4	5	20	12	17	7	1	16	19	6	11	9	13	18	8	14	3	0.00262
Anak 8	6	13	18	20	7	8	15	5	16	3	12	17	1	11	14	19	10	4	2	9	0.00225
	Kromosom																				Fitness
Anak 9	8	9	3	6	15	20	1	16	12	5	2	18	19	10	17	11	7	4	14	13	0.00231
Anak 10	20	16	7	4	8	14	12	13	1	17	5	18	19	9	2	3	6	11	15	10	0.00235
	Kromosom																				Fitness
Anak 11	17	9	7	10	5	12	3	16	15	11	6	14	19	8	2	1	20	13	18	4	0.00289
Anak 12	6	20	13	4	16	11	17	1	12	14	9	3	2	8	19	18	15	7	5	10	0.00238
	Kromosom																				Fitness
Anak 13	15	11	17	5	7	14	6	13	8	3	1	`	12	9	10	18	20	19	4	16	0.00231
Anak 14	18	11	1	13	19	20	16	4	15	5	7	3	9	2	10	14	8	17	6	12	0.00238

5. Mutation

The process of mutation is a process to replace the missing genes from the population in the process of selection, in addition to producing genes not found in the initial populations. This mutation process done upon random numbers generated random numbers, if the value is greater than the probability of a mutation, then that individual will not be demoted, but if the value of the random number is less than the chance of mutation then that individual will be in a mutation. The mutation process done by changing one or more genes in the chromosomes. The methods used in the process of this mutation is a mutation of the binary method.

Table 5. Chromosome Mutation

Kromosom Kena Mutasi																				
10	4	2	17	15	6	5	11	14	12	16	7	9	8	10	1	18	20	13	19	3
11	4	8	1	11	2	3	17	13	16	20	7	15	10	6	12	14	19	5	18	9
12	14	8	16	6	2	15	12	3	5	19	18	9	1	10	20	4	7	11	17	13

Kromosom Hasil Mutasi																				
10	4	2	17	12	6	5	11	14	15	16	7	9	8	10	1	18	20	13	19	3
11	4	17	1	11	2	3	8	13	16	20	7	15	10	6	12	14	19	5	18	9
12	14	8	16	6	2	15	12	3	5	19	18	20	1	10	9	4	7	11	17	13

6. Preservation of the best Individual

After doing all the steps, it will obtain optimal results, although not necessarily produce the most optimal. To get optimal results must be made up to the 100th generation.

The results of the population end of 1st generation, would later serve as the population early in the process to do the 2nd generation, starting from the stage of selection, crossover, mutation and the preservation of individual best again. This process will be repeated until the maximum generation always to-100. Then get the final generation to population-100 and will be selected based on the value of the largest fitness to serve as the optimal route. Results of 1st Generation can be seen in table 6.

Table 6. Preservation of the best individual – Generation to-1

Kromosom	Populasi Awal																														Fitness
1	4	8	12	19	14	1	20	10	2	3	13	11	9	17	15	6	18	7	5	16											0.00236
2	11	4	18	19	17	15	8	13	10	12	20	2	6	14	3	16	5	7	1	9											0.00301
3	1	16	10	18	19	4	8	6	3	12	15	20	13	7	11	14	5	2	17	9											0.00255
4	8	15	6	9	3	14	5	17	2	1	20	7	18	13	10	16	4	12	19	11											0.00233
5	17	9	15	13	20	1	10	3	2	5	11	12	8	19	6	18	14	16	4	7											0.00207
6	13	17	5	6	1	12	14	16	3	11	7	2	19	9	18	10	20	4	8	15											0.00253
7	15	20	2	11	9	13	7	19	8	12	10	1	14	16	5	3	6	18	4	17											0.00293
8	12	1	15	10	17	13	8	20	14	18	9	16	5	4	3	7	11	19	2	6											0.00222
9	4	19	8	13	14	3	9	5	2	17	12	6	18	7	10	20	11	16	1	15											0.00274
10	4	2	17	15	6	14	12	3	5	19	18	9	1	10	20	8	7	11	16	13											0.00239
11	4	17	1	11	2	3	8	13	16	20	7	15	10	6	12	14	19	5	18	9											0.00259
12	14	8	16	6	2	5	11	15	12	17	7	9	4	10	1	18	20	13	19	3											0.00249
13	19	14	6	13	8	20	4	10	16	17	1	12	11	5	18	9	15	2	3	7											0.00240
14	6	4	19	17	7	14	12	15	8	13	18	3	5	10	9	2	20	11	16	1											0.00247
15	7	8	19	11	5	2	3	20	1	4	17	15	18	9	10	13	12	16	6	14											0.00195
16	7	4	2	13	10	6	12	15	11	16	9	5	17	3	8	14	19	20	18	1											0.00261
17	8	3	4	10	13	14	12	18	5	9	19	6	17	7	2	1	16	15	20	11											0.00244
18	10	14	5	20	15	6	4	13	1	9	18	16	12	7	3	19	17	8	11	2											0.00277
19	2	12	18	4	7	20	13	19	6	9	8	17	5	3	1	10	11	14	15	16											0.00221
20	20	19	9	14	5	1	2	3	6	16	10	18	11	15	13	7	17	12	8	4											0.00312
21	15	10	2	4	5	20	12	17	7	1	16	19	6	11	9	13	18	8	14	3											0.00262
22	6	13	18	20	7	8	15	5	16	3	12	17	1	11	14	19	10	4	2	9											0.00225
23	8	9	3	6	15	20	1	16	12	5	2	18	19	10	17	11	7	4	14	13											0.00231
24	15	8	7	5	19	4	3	1	9	13	18	2	16	10	20	12	14	17	6	11											0.00253
25	20	16	7	4	8	14	12	13	1	17	5	18	19	9	2	3	6	11	15	10											0.00235
26	17	9	7	10	5	12	3	16	15	11	6	14	19	8	2	1	20	13	18	4											0.00289
27	6	20	13	4	16	11	17	1	12	14	9	3	2	8	19	18	15	7	5	10											0.00238
28	15	11	17	5	7	14	6	13	8	3	1	2	12	9	10	18	20	19	4	16											0.00231
29	18	11	1	13	19	20	16	4	15	5	7	3	9	2	10	14	8	17	6	12											0.00238
30	4	7	9	18	10	15	1	20	14	5	8	11	12	6	2	3	19	13	16	17											0.00217

RESULTS AND DISCUSSION

To facilitate the search for a fast route, created the application program by using the method of application Testing done GA. by as much as 10 times the experiment and with each iteration of the experiment 100 iterations. The parameters used in this application is the probability of crossover probability and mutation of 0.1-0.5, with a total population of 30 populations as well as the number of customers as much as 20.

Table 7. Comparison of Testing as Much as 1000 Iterations

Percobaan	Iterasi	Kendaraan 1	Total Jarak (km)	Kendaraan 2	Total Jarak (km)	Kendaraan 3	Total Jarak (km)	Kendaraan 4	Total Jarak (km)	Kendaraan 5	Total Jarak (km)	Sub Total Jarak (km)
1	100	0-17-7-12-14-0	391.4	0-4-15-0	51.6	0-16-6-8-0	80.2	0-20-13-11-2-18-0	69.6	0-10-19-1-5-9-3-0	103.9	696.7
2	200	0-11-17-7-6-0	92	0-8-5-9-16-0	101.5	0-8-5-9-16-0	93.1	0-15-4-0	53.1	0-20-13-11-2-18-0	69.6	409.3
3	300	0-12-17-7-6-0	92	0-20-4-11-13-0	64.9	0-19-3-9-1-10-18-0	95	0-15-2-0	55.7	0-8-14-5-16-0	80.2	387.8
4	400	0-16-6-8-0	80.2	0-14-5-12-9-17-18-0	106.9	0-20-7-3-11-0	116.7	0-4-13-10-1-19-0	87.6	0-15-2-0	55.7	447.1
5	500	0-16-5-1-17-6-18-0	107	0-8-7-12-0	89.2	0-20-13-11-2-0	66.1	0-15-4-0	53.1	0-3-9-14-10-19-0	102.7	418.1
6	600	0-10-6-19-5-1-3-0	95.4	0-11-17-7-9-16-0	114.8	0-20-4-12-0	84.9	0-15-2-0	55.7	0-13-8-14-18-0	69.8	420.6
7	700	0-13-8-14-18-0	69.8	0-15-2-0	55.7	0-16-5-12-6-10-0	85.3	0-19-3-9-1-11-4-0	96.1	0-20-17-7-0	101.9	408.8
8	800	0-13-1-9-3-7-18-0	100.8	0-15-2-0	55.7	0-20-4-12-0	84.9	0-11-8-14-19-0	91.4	0-16-10-6-5-17-0	119.4	452.2
9	900	0-3-9-10-6-19-0	103.1	0-8-1-5-16-0	83.8	0-20-4-11-13-0	64.9	0-15-2-18-0	59.2	0-12-17-7-14-0	88.3	399.3
10	1000	0-12-17-7-5-16-0	100.9	0-13-8-6-0	68.8	0-15-2-18-0	59.2	0-4-10-9-1-19-0	99.6	0-20-11-14-3-0	116.6	445.1

To facilitate the calculation and calculation, the conversion is done with the customers form name. Each vehicle must not exceed the limits of the capacity of the vehicle, i.e. weighing 2 tons so that each request be sent must not be more than 2 tons. In Table 7, application testing has been performed in accordance with routes and capacity problems, problems of the vehicle. Application testing is performed as much as 1000 times iteration. As many as 1000 iterations, it brings the most subtotal distance lies in small iterations performed as much as 300 times the iteration, with a total mileage of 387.8 km.

Table 9. Route Distribution with 300 Iterations

Kendaraan 1	Kendaraan 3	Kendaraan 5
Depot - Carrefour Alfa Pasar Minggu	Depot - Hero Gatot Subroto	Depot - Carrefour MT Haryono
Carrefour Alfa Pasar Minggu - Giant SPM Lebak Bulus	Hero Gatot Subroto - Carrefour Blok M Square	Carrefour MT Haryono - Giant Kalibata
Giant SPM Lebak Bulus - Carrefour Lebak Bulus	Carrefour Blok M Square - Carrefour Permata Hijau	Giant Kalibata - Carrefour Kota Kasablanka
Carrefour Lebak Bulus - Carrefour Kramat Jati	Carrefour Permata Hijau - Carrefour Ambassador	Carrefour Kota Kasablanka - Giant Plaza Semanggi
Carrefour Kramat Jati - Depot	Carrefour Ambassador - Carrefour Taman Mini	Giant Plaza Semanggi - Depot
	Carrefour Taman Mini - Giant SPM Pekayon	
	Giant SPM Pekayon - Depot	
Total Jarak: 92 Km	**Total Jarak: 95 Km**	**Total Jarak: 80.2 Km**

Kendaraan 2	Kendaraan 4
Depot - Indomaret DC Jababeka	Depot - Giant Metland Transyogi
Indomaret DC Jababeka - Carrefour Blue Mall Bekasi	Giant Metland Transyogi - Carrefour Bekasi Square
Carrefour Blue Mall Bekasi - Carrefour Alfa Bekasi Harapan	Carrefour Bekasi Square - Depot
Carrefour Alfa Bekasi Harapan - Giant Hypermarket Bekasi	
Giant Hypermarket Bekasi - Depot	
Total Jarak: 64.9 Km	**Total Jarak: 55.7 Km**

CONCLUSIONS AND SUGGESTIONS

Conclusions that can be drawn are as follows:

1. Genetic algorithms can be used for solving Vehicle Routing Problem (VRP).
2. Search results for alternative routes vary, this is due to several factors such as the number of iterations performed as well as random numbers that appear, the search resulted in the route is not able to get the same results per search.

Some suggestions that can be made into consideration for the following companies:

1. Companies are advised to use this application to determine the distribution routes so that the distribution fee may be in minimize and can be estimated.
2. Further research is expected to consider the congestion, as the basis of calculation of the distance between consumer and depot.
3. Further research is recommended to develop Hybrid Genetic Algorithm method so as to provide a more optimal results.

BIBLIOGRAPHY

Arief, N. W. (2011, April 15). *Aspek Teknologi Informasi dalam Lingkungan Bisnis.* Retrieved from Amikom: http://research.amikom.ac.id/index.php/KIM/article/view/4373/2707

Bräysy, O. (2001). Genetic Algorithm for the Vehicle Routing Problem with Time WIndows. *Transportaion Science*, 33-38.

Gaol, D. C. (2008). *Sistem Informasi Manajemen: Pemahaman dan Aplikasi.* Jakarta: PT Grasindo.

Gaspersz, V. (2009). *Production Planning and Inventory Control Berdasarkan Pendekatan Sistem Terintegrasi MRP II dan JIT Menuju Manufakturing 21.* Jakarta: Gramedia Pustaka Utama.

Kusumadewi, S., & Purnomo, H. (2010). *Penyelesaian Masalah Optimasi dengan Teknik-teknik Heuristik.*

Man, K. F., Tang, K. S., & Kwong, S. (1996). Genetic Algorithms: Concepts and Applications. *IEEE Transactions on Industrial Electronics*(Vol. 43), 519-534.

Mutakhiroh, I., Saptono, F., & Wiryadinata, R. (2007). Pemanfaatan Metode Heuristik Dalam Pencarian Jalur Terpendek Dengan Algoritma Semut dan ALgoritma Genetika. *Seminar Nsional Aplikasi Teknologi Informasi*, 33-39.

O'Brien, J. A. (2005). *Pengantar Sistem Informasi Perspektif Bisnis dan Manajerial.* Jakarta: Penerbit Salemba Empat.

Ong, J. O., & Suprayogi. (2011). Vehicle Routing Probelm With Backhaul Multiple Trips and Time Window. *Jurnal Teknik Industri*(Vol. 13), 1-10.

Satzinger, J. W., Jackson, R. B., & Burd, S. D. (2004). *Systems Analysis and Design in Changing World, Third Edition.* United States of America: Thomson Learning, Inc.

Sutapa, I. N., & Widyadana, I. G. (2003). Studi Tentang Travelling Salesman Dan Vehicle Routing Problem Dengan Time Windows. *Jurnal Teknik Industri Vol. 5, No. 2*, 81-89.

Tanujaya, W., Dewi, D. R., & Endah, D. (2011). Penerapan Algoritma Genetik Untuk Penyelesaian Masalah Vehicle Routing Di PT. MIF. *Widya Teknik*(Vol. 10), 92-102.

Wijaya, S. F., & Alianto, H. (2012). *Esensi dan Penerapan ERP dalam Bisnis.* Yogyakarta: Graha Ilmu.

Yakub. (2012). *Pengantar Sistem Informasi Edisi Pertama.* Yogyakarta: Graha Ilmu.

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