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Murat Köksalan, Sakine Batun,

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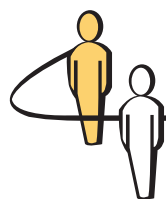
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Case

Assigning Regions to Sales Representatives at Pfizer Turkey

Murat Köksalan

Department of Industrial Engineering, Middle East Technical University, 06531 Ankara, Turkey,
koksalan@ie.metu.edu.tr

Sakine Batun

Department of Industrial Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania 15261,
sab79@pitt.edu

Note: The information on the pharmaceutical sector and the company are accurate as collected from various cited sources. The problem contains all the characteristics of the underlying problem faced by Pfizer. It has been simplified to keep the model size manageable as a case study, and the data have been altered for confidentiality. The authors created the case material based on past collaboration with Pfizer (Batun et al. 2004). All the characters introduced throughout the case are fictional.

1. Introduction

Merih Caner, the vice president of logistics, has been thinking that it is about time to renew the territories of the SRs countrywide. It has been several years since the last update and the demand structure for pharmaceutical products has changed substantially. He knows that it is important to keep the total travel distance short and that it is not a good idea to make drastic changes in the existing territories. He also knows that maintaining a somewhat balanced workload among the SRs is important. They have always considered these issues when updating the territories and he is confident that they are still crucial. What he is not so sure about is whether they could adopt a more structured approach than trial and error to come up with satisfactory territories. He calls his assistant, Serdar Altan, to a meeting to discuss these issues.

2. Company Background: Pfizer Global

Pfizer Inc, founded in 1849 in Brooklyn, NY, aims to help people and animals live longer and healthier

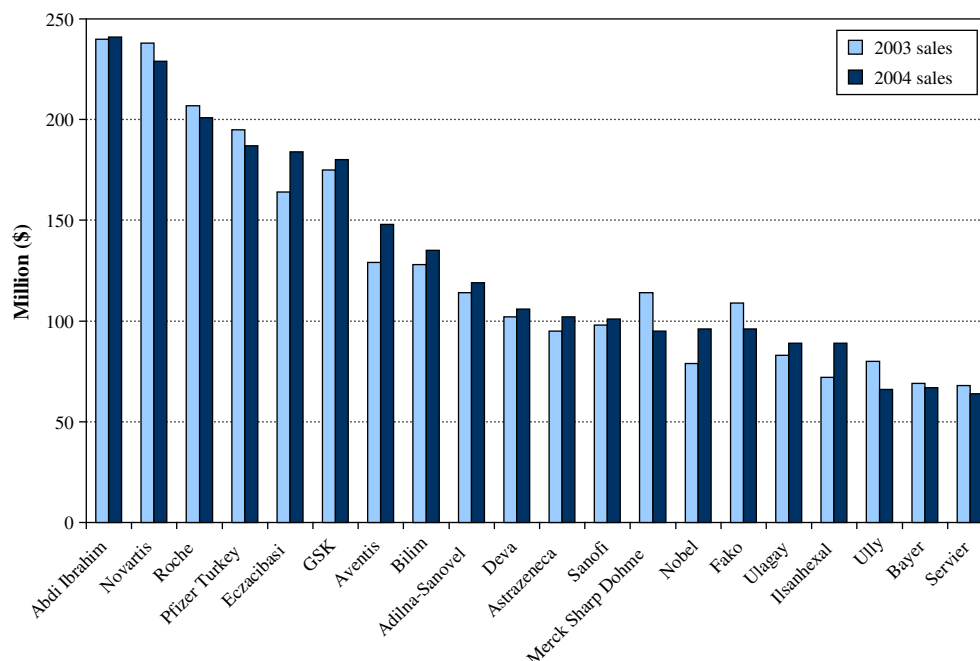
lives. To attain this goal, the company “discovers and develops breakthrough medicines; provides information on prevention, wellness and treatment; and carries out high quality manufacturing of medicines” (Pfizer UK 2006). Currently, Pfizer has 122,000 employees in 60 countries and the medicines developed and manufactured by the company are marketed/sold in more than 150 countries.

In 2004, the overall investment of Pfizer in R&D was approximately \$7.9 billion, the largest among all pharmaceutical companies worldwide. The revenues and the R&D expenditures of the company are reported as \$51.3 Billion and \$7.4 Billion, respectively, in 2005 (Pfizer Home 2006).

3. The Pharmaceutical Sector in Turkey

The emergence of pharmaceutical companies in Turkey dates back to the early nineteenth hundreds. Large scale manufacturing started around 1923, and the manufacturing of pharmaceuticals shifted from drugstores to laboratories and small plants after 1928. Especially in the last 20 years, investments by foreign companies have increased substantially because of Turkey’s proximity to the European market and qualified workforce. According to the latest figures provided by the Ministry of Health (see Seyhan et al. 2006), there are 300 companies operating in the Turkish pharmaceutical market. Eighty-five of those companies have their own manufacturing plants, and 11 companies are active pharmaceutical ingredient (API)

Figure 1 Pharmaceutical Company Sales in Turkey—2003 and 2004 (\$ Million)

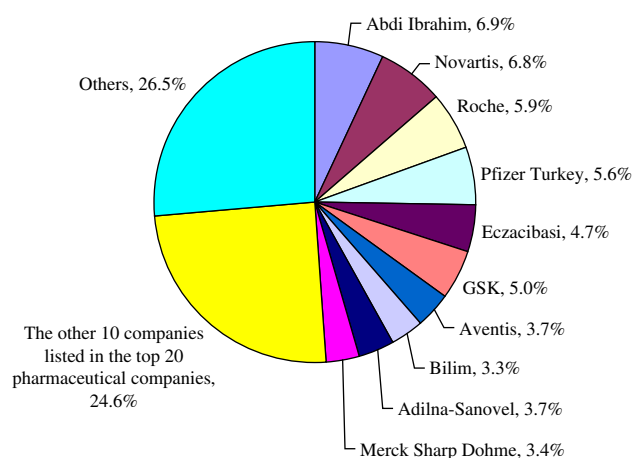


producers. The remaining companies import or subcontract from other manufacturers.

According to 2005 figures, the Turkish pharmaceutical market is the 12th largest in the world with \$6.6 billion in the total sales value of finished products at manufacturers' price. Approximately half of this market relies on imports (Seyhan et al. 2006).

Figure 1 shows annual sales in 2003 and 2004 of the top 20 pharmaceutical companies in Turkey. As Figure 2 shows, about 75% of the market is controlled by 20 companies. Pfizer Turkey, with a market share of 5.6%, ranks fourth among these companies (Sezan 2005).

Figure 2 Market Shares of Pharmaceutical Companies in Turkey (Reported in 2005)



4. Pfizer Turkey

As a part of Pfizer's global expansion, Pfizer Turkey was founded in Istanbul in 1957. Despite initially having a small plant designed to manufacture a few products, Pfizer Turkey gradually expanded its capacity to satisfy increasing demand. In 2004, the company had 7% of Turkey's pharmaceutical exports with an export value of \$19 million. According to the activity reports of 2005, the exports increased to \$23 million and 17 different products were exported to 24 markets worldwide. Together with the imported products, Pfizer Turkey supplied 121 different products with 356 different presentations amounting to 44 million boxes of supply volume, which constitutes 3.22% of the total pharmaceutical production in 2005 (Seyhan et al. 2006, Pfizer Turkey 2006).

5. Assigning Regions to Sales Representatives

Pfizer Turkey's immediate customers are medical doctors (MDs) because a majority of its products are prescription drugs. Pfizer pharmaceutical sales representatives (SRs) maintain close relationships with MDs through regular visits. In addition to discussing and obtaining feedback, SRs provide MDs with supply samples and information on indications for drugs and potential adverse effects. There is strong evidence that this strategy helps the sales of Pfizer's products.

Each SR is assigned a working region, called a *sales territory* or simply a *territory*, which is a list of MDs to be visited. Territories are formed by combining

smaller geographical units, called *bricks*. A brick is the smallest geographical region for which relevant information, such as sales data, number of MDs, and MD profiles is available. Based on this information, Pfizer calculates an index value for each brick. The index value is a composite figure developed at Pfizer that captures various factors to show the workload of the brick in terms of the number of SRs required for it. Typically, the index value is fewer than one and a territory is composed of several bricks.

Each SR is in an office at a certain brick, which is considered the center of his/her territory. The sum of index values of the bricks of an SR correspond to his/her total workload and should be approximately 1. It is not possible to achieve a workload of exactly 1 unit per SR because partial assignments of bricks to multiple SRs are undesirable.

To maintain overall travel efficiency, it is necessary to minimize the total distance traveled by the SRs. The total distance traveled by an SR (within his/her territory) can be measured by the sum of distances between the office (i.e., the center brick) and the (centers of the) bricks assigned to the SR as demonstrated in Figure 3.

Because of the dynamic structure of the market, i.e., changes in the number of customers or in the sales of products in each brick, the index values change over time. Hence, sales territories should be periodically reconstructed to maintain workload balance between territories. Another concern, minimizing disruption, emerges here because of changing some of the existing territories and reconstructing new ones. Disruption is defined as the inclusion of new bricks in the territories of SRs. Disruption is undesirable as some of the established relationships between SRs and MDs cannot be used any more.

Serdar Altan has an MBA and Merih Caner has a lot of confidence in his skills. Merih asked him to bring Sevil Korkmaz to the meeting as well. Sevil has an MS in industrial engineering. Serdar and Sevil recently completed a production-planning project and earned

a good reputation in the company despite their youth. Merih thinks that this is a good time to get them involved and start the reorganization study of the territories.

Merih: You know the territories of our SRs were determined several years ago. Things have changed quite a lot since then and we should be able to improve this. The variation between the workloads of SRs seems to have increased a lot and I hear that some SRs are already complaining. I am not sure we are doing the best we can do in terms of total travel distance either. We should be able to measure and improve these as much as possible without creating too much disruption. I believe the timing is just right to make some changes. In the past, we have done this with trial and error but I have always felt that there should be a better way.

Sevil: I have also been thinking about this. It resembles a problem we have seen in our MS program. We need to assign each brick to an SR and each SR has a work capacity. We can try to define a mathematical model.

Serdar: Yes, I am also familiar with such models. I am not sure what our objective will be though. We have different concerns. We need to consider the travel distance and make sure not to reassign too many bricks.

Merih: You also need to make sure that there is a reasonable balance of workload among SRs. Otherwise, they will all blame us. But it seems you have some ideas, why don't you work on those a bit. Let us schedule another meeting, would two days be enough to develop those ideas?

Serdar: We will do our best.

Sevil and Serdar were a bit worried after the meeting. Merih always expects quick results. On the other hand, he has a good intuition on these matters and they knew that he would be supportive if they had difficulties. First, they collected the documents and studied the current situation. There were 1,000 bricks and 196 SRs nationwide. Looking at the overall workload and the trends, they knew that there was no need for new SRs in the near future. They quickly realized that the model would have too many binary variables to be of practical value. They remembered that large integer models would cause computational difficulties, and that specialized software to exploit special structures could be necessary. They further analyzed the current system on the map.

Serdar: Doesn't this problem have a special structure that would give integer results when solved as a linear program? We should be able to solve the large problem without difficulty then.

Sevil: I also thought about it and looked it up. Our problem resembles the "assignment problem" which

Figure 3 Territory of an SR

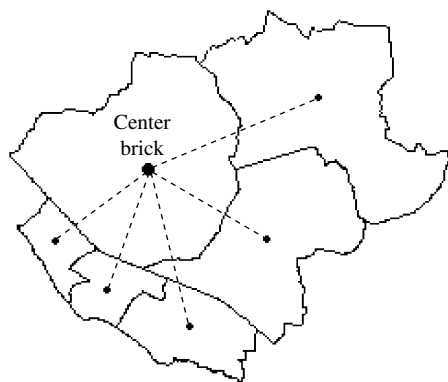


Table 1 Current Structure of Sales Territories

SR no.	Center brick no.	Bricks assigned
1	4	4, 5, 6, 7, 8, 15
2	14	10, 11, 12, 13, 14
3	16	9, 16, 17, 18
4	22	1, 2, 3, 19, 20, 21, 22

has the structure you mentioned. But I think our different objectives will destroy this structure. In order to see the trade-offs between the objectives and to obtain different solutions we will have to introduce additional constraints to the problem. My experience is that such constraints usually cause problems. In any case, once we set up an example problem, we can solve the LP relaxation and see what happens.

Serdar: Okay. Even if it does not give an integer solution, I find the LP relaxation very useful. It yields a lot of insight.

Sevil: I agree. To reduce the problem size we may perhaps use the geographical districts. It seems that there are very few common aspects between districts. The problem seems to be naturally separable.

Serdar: Great! Then we would need to solve many small problems. If there are neighboring districts for which this separation is not so clear, we can combine and solve them together.

They decided to use an example district and try to get some results before the meeting with Merih. They chose a typical district in Istanbul with 4 SRs and 22 bricks. Table 1 shows the current structure of the sales territories, i.e., the center brick of each SR and the bricks assigned to him/her. Tables 2 and 3 provide new index values of the bricks and the travel distances between these bricks and SR offices (center bricks), respectively. Figure 4 shows the brick locations.

Sevil and Serdar decided to treat the workload balance objective as a constraint. They also decided to try to restrict the workload of each SR to the interval [0.8, 1.2] because they believed this level of variation would be acceptable.

Table 2 Index Values of Bricks

Brick no.	Index value	Brick no.	Index value
1	0.1609	12	0.0828
2	0.1164	13	0.0975
3	0.1026	14	0.8177
4	0.1516	15	0.4115
5	0.0939	16	0.3795
6	0.1320	17	0.0710
7	0.0687	18	0.0427
8	0.0930	19	0.1043
9	0.2116	20	0.0997
10	0.2529	21	0.1698
11	0.0868	22	0.2531

Table 3 Travel Distances between SR Offices and Bricks (km)

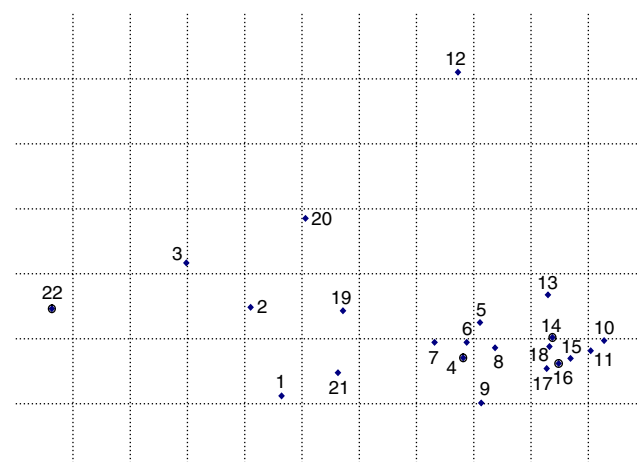
Brick no.	SR no.			
	1	2	3	4
1	16.16	24.08	24.32	21.12
2	19.00	26.47	27.24	17.33
3	25.29	32.49	33.42	12.25
4	0.00	7.93	8.31	36.12
5	3.07	6.44	7.56	37.37
6	1.22	7.51	8.19	36.29
7	2.80	10.31	10.95	33.50
8	2.87	5.07	5.67	38.80
9	3.80	8.01	7.41	38.16
10	12.35	4.52	4.35	48.27
11	11.11	3.48	2.97	47.14
12	21.99	22.02	24.07	39.86
13	8.82	3.30	5.36	43.31
14	7.93	0.00	2.07	43.75
15	9.34	2.25	1.11	45.43
16	8.31	2.07	0.00	44.43
17	7.31	2.44	1.11	43.43
18	7.55	0.75	1.53	43.52
19	11.13	18.41	19.26	25.4
20	17.49	23.44	24.76	23.21
21	11.03	18.93	19.28	25.43
22	36.12	43.75	44.43	0.00

Sevil: How do we measure the travel distance and the reassignment objectives? The travel distance objective would be straightforward if an SR returned to the office after visiting each brick. I suppose this is not a bad assumption. I believe this would not change the solutions much. If we try to incorporate the sequence of visiting the bricks into this problem, I am afraid it will be too complicated to solve.

Serdar: I agree. The additional benefit will also be marginal. To measure the disruption, couldn't we just count the number of bricks for which the new assignment is different from the current assignment?

Sevil: Wouldn't we be counting them twice then? Assigning a brick to a new SR means removing it from another SR's territory. So, it may be more

Figure 4 Brick Locations



meaningful to count either the number of bricks assigned to a different SR, or the number of bricks removed from an SR's current territory.

Serdar: Yes, you're right. We should be careful about it. When we just count, we are treating all the bricks the same way. It is actually less desirable to disrupt a brick having a higher index value. New relationships will have to be established between more MDs.

Sevil: Yes, that's a good point. Why don't we use the index values of bricks while measuring the disruption? Would weighing each disrupted brick with its index value be a good metric to measure the disruption?

Serdar: It surely would.

They then discussed how to obtain different solutions. They checked their books and noted that a solution is efficient if there is no other feasible solution that is at least as good in every objective and strictly better in at least one objective. They recalled from their graduate studies that they had to make sure to obtain efficient solutions. They decided to use a method that would put an upper bound on the disruption objective and minimize the distance traveled. By changing the upper bound value, they would obtain several solutions.

Serdar: When we use this method, are we guaranteed to obtain an efficient solution? The second objective is treated as a constraint and it seems to me that the model would not differentiate between solutions that have the same minimum distance traveled but different disruption values so long as the upper bound is satisfied.

Sevil: Exactly. The book discusses this issue right here. It says the solution found can be inefficient because of this. But there is a practical solution. We can multiply the second objective's value with a very small positive constant and add to the distance traveled in the objective function. This trick breaks ties in favor of solutions that have better values in the "disruption" objective.

Serdar: I like this trick. Okay, we have very little time left before the meeting. It would be great if we could obtain some solutions we can show to Merih.

They obtained several efficient solutions and were pleasantly surprised to see how much they accomplished in two days. They explained what they did and showed their results to Merih.

Merih: These look good for a start. It gives me some idea about the possible solutions. Before making a decision, I would like to see more solutions though. Would it make sense to obtain all efficient solutions? Would there be too many?

Sevil: I think there could be too many in general. There may not be too many for this problem, though. We can try and see.

Merih: I am also interested to see the effect of tightening the "balance" range. If the other objectives do not deteriorate too much, I would like to have the workload balanced a little more. Perhaps you can plot the solutions you obtain. I will also welcome any comments on the solutions that would facilitate the decision. If we can analyze this district well, then we can make the decisions for other districts in a similar way.

Serdar: We intended to prepare a plot but ran out of time. We will do it next time. Hopefully, we will not be pressed with time as much now!

Merih: I understand. I will not give you a deadline this time. You let me know when you are ready.

Leaving the meeting, Sevil and Serdar were not sure if they were better off with or without the deadline. They knew that they would work even harder now. It occurred to them that Merih also knew it. "No wonder he is the vice president," Sevil thought.

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