Project Switchblade Analysis

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GitHub Repo: https://github.com/mitchb63/Project_Switchblade

INTRODUCTION

This project was created as part of Wittenberg University's ANLT 540 course in Descriptive, Predictive, and Prescriptive Analytics. An email chain was presented describing the current status of Project Switchblade, which is an investigation into the fictional company Big Tech 3's possible response to changes in the European mobile phone market conditions. In addition to the email chain, five data files were provided:

- European Customer Feature Survey
- FreeMobile Contract Summary
- Manufacturing Report
- Model Line Features and Costs
- Prior Year Sales Figures

Using information contained in the emails and data files, questions and requests for additional data were to be formulated. Once received, a comprehensive analytics plan was built to address the problem and preliminary analysis conducted with initial recommendations.

PROBLEM DEFINITION

Big Tech 3 is a company specializing in the production of mobile phones. One of its biggest customers, FreeMobile, will begin to manufacture their own phones instead of purchasing them from Big Tech. Since FreeMobile is the largest carrier in the European market, holding 45% ownership, this shift could have a significant impact on Big Tech's sales and result in a loss of up to 40% market share by 2023. This analysis plan investigates three hypotheses that could help compensate for this potential loss of revenue and market share.

HYPOTHESES

The following hypotheses have been proposed by Big Tech's management team and will be evaluated in the analysis plan that follows:

- **New Phone Models** - Big Tech has three new phone models in development. Introducing these models into the European market could increase sales and reduce the loss of market share to FreeMobile.

- **Factory Upgrades** - One of Big Techs' manufacturing plants, the Poland site, is currently running at full capacity with older equipment. Investing in upgrades to the Poland plant could increase production capacity and reduce costs thereby helping compensate for the loss of sales to FreeMobile.
- **Partnership Opportunities** - Partnering with other carriers to share sales and marketing costs could help increase the coverage of carriers still contracting with Big Tech and thereby increase market share.

Analytic Plan

New Phone Models

To evaluate the potential of new phone models, exploration will begin using a variety of descriptive analytic methods. Trend analysis will be used to examine the sales of each of the current models. This will be done for the European market as a whole, as well as on an individual country level. The profit margins for each phone model will be examined as well as the projected revenue and margins for the three new models if they are introduced into the European market. Finally, survey data will be analyzed to explore how Big Tech's product offerings align with consumer needs.

Factory Upgrades

To evaluate the need and effectiveness of upgrades to Big Tech's manufacturing plants, descriptive, predictive, and prescriptive analytics will be applied. Descriptive techniques will be used in order to create a system model that reflects the current state of the production facilities. This process will include back calculating the number of each type of machine currently in operation at each plant as well as the number of operators required. Age and efficiency of the machinery, and the labor and shipping costs associated with production at each individual facility will be included in order to create a system model that can be used to conduct what-if analysis. Current sales data will then be used to predict future sales. The system model will be used to evaluate a variety of scenarios to determine the ability of Big Tech's manufacturing plants to meet the anticipated future demand. Situations where new phone models are introduced to the European market will be compared to the current marketing strategy, and scenarios both with and without plant expansions will be explored. The model will provide an optimized solution and recommendations that will maximize Big Tech's profits while meeting anticipated product demands.

Partnership Opportunities

There are currently two partnership opportunities that have been put forward. Blipper wishes to launch their own branded phone line. They are willing to pay a 5% margin over and above the margin Big Tech currently receives on sales to Blipper. GMT also wants to attempt to take market share from FreeMobile. They want to partner with Big Tech to share marketing costs. It is estimated that this could increase market share by 10% at a cost of $1.5 per unit. The

implications of both of these opportunities will be examined including their potential impact on profit and manufacturing capacity.

RESULTS & RECOMMENDATIONS

NEW PHONE MODELS

Big Tech currently holds 43% of the $853.5 million European cell phone market. Economic growth in 2016 was 1.6%. Assuming that growth rates remain steady, Big Tech 3's projected market share for 2017 is 40% of the market or $346.9 million.

Sales in the European market are generally increasing across all models as shown in Figure 1. Models 4 and 5 are showing the highest sales and greatest rates of increase. Models 1 and 6 are fairly stagnant in terms of growth.

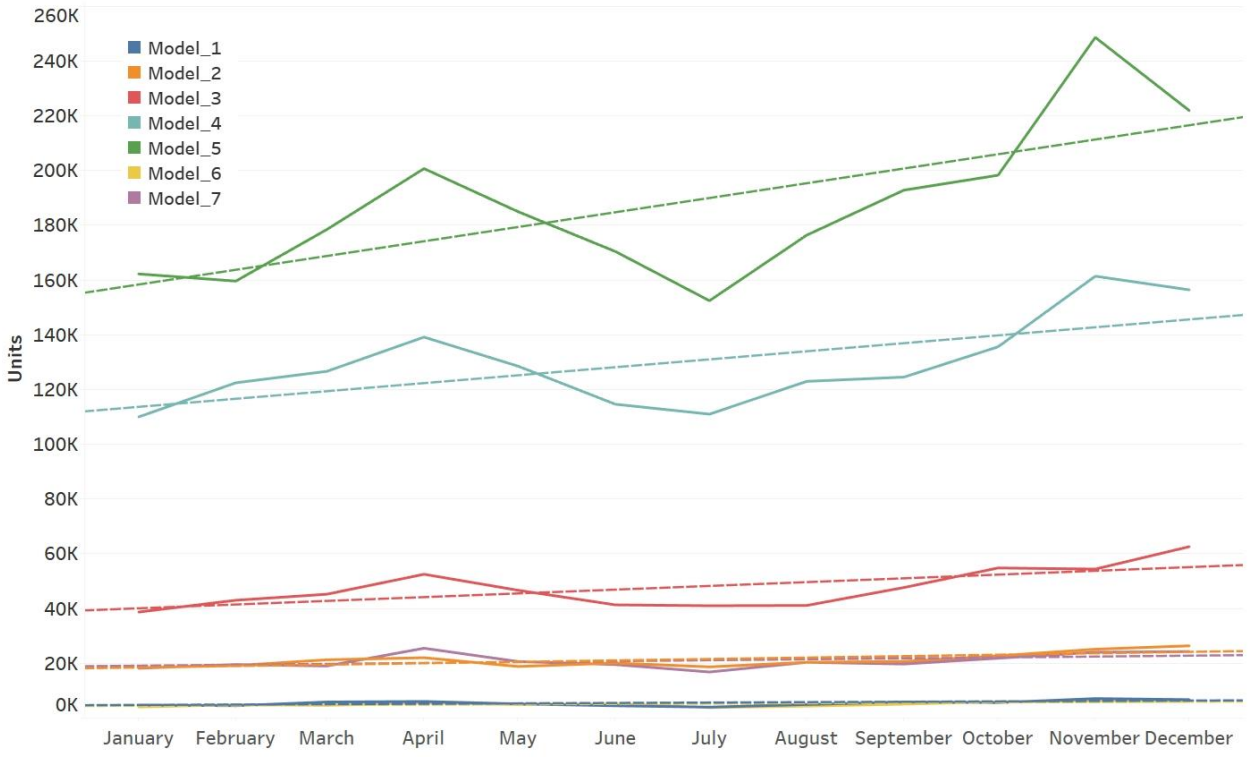


Figure 1 – 2016 European Sales by Model

Using data from the past 12 months, an exponential smoothing model was created to predict sales in the European market for 2017. Predicted sales figures for phone Models 8, 9 and 10 are based on percentages from global production figures. The results are shown in Table 1 along with the figures for profit margin and resulting overall profit (projected demand and profits were calculated with a 95% confidence interval). Model 4 has the highest margin at $45.38/unit. The lowest three are Model 6 at $12.66, Model 5 (highest selling model) at $15.55, and Model 1 at $16.67/unit.

Table 1 – Projected European Sales and Profit by Model

Model	Min Demand (units)	Max Demand (units)	Revenue/Unit	Profit/Unit	Min Profit	Max Profit
Model 1	53068	103244	$42.31	$16.67	$884,642	$1,721,079
Model 2	241629	354987	$50.79	$20.16	$4,871,250	$7,156,528
Model 3	565150	811586	$65.13	$27.43	$15,502,068	$22,261,800
Model 4	1308133	2310491	$102.12	$45.38	$59,363,056	$104,850,101
Model 5	1167431	4127041	$70.63	$15.55	$18,153,553	$64,175,486
Model 6	61078	81794	$59.33	$12.66	$773,245	$1,035,515
Model 7	121151	372337	$97.37	$39.00	$4,724,901	$14,521,131
Model 8	30400	58360	$139.17	$61.60	$1,872,640	$3,594,976
Model 9	436239	820933	$126.67	$57.01	$24,869,985	$46,801,390
Model 10	168970	301698	$131.41	$57.43	$9,703,947	$17,326,516

Based on this analysis, we believe that, due to their low sales numbers and profit margins, consideration should be given to discontinuation of Models 1 and 6 in the European market and their replacement with better selling and more profitable models. Models 8, 9, and 10 could provide up to an additional $67.7 million in profit. We feel that the likelihood of generating this additional profit can be increased based on insights gained from consumer survey data as described below.

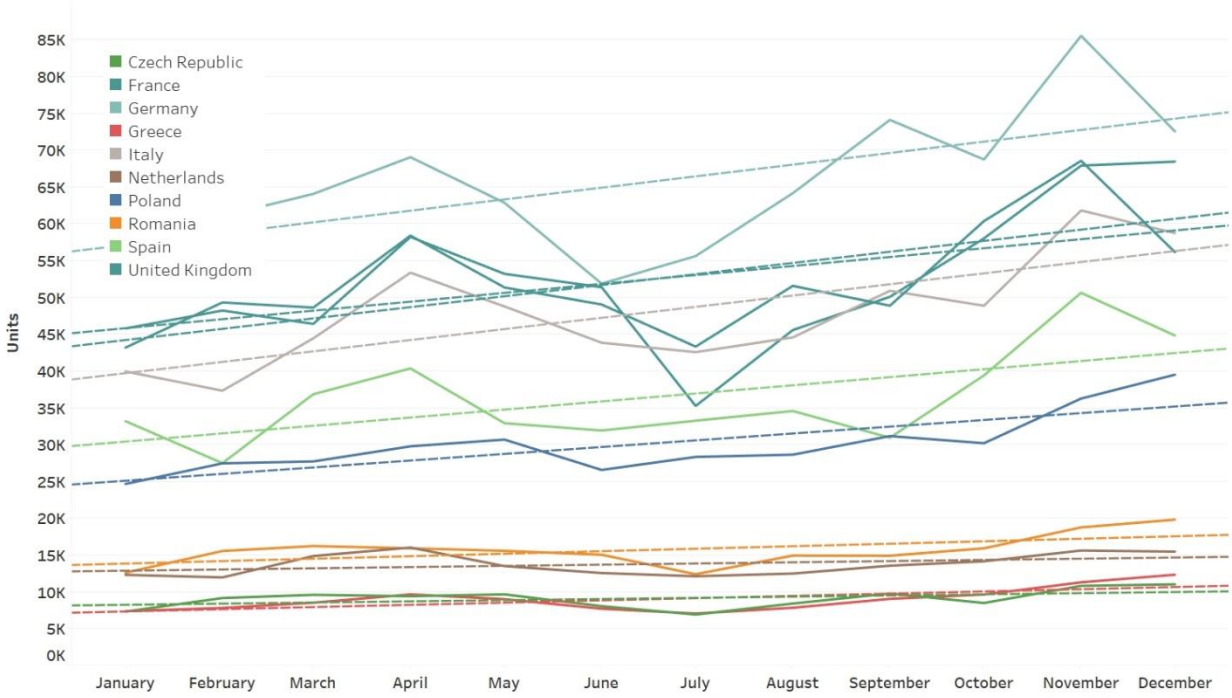


Figure 2 – 2016 Sales by Country (Top 10 Countries - European Market)

Figure 2 shows 2016 sales (in units) for the top 10 European countries. While there were some sales declines during the Summer months, overall, sales trends were positive. This held true for all European countries, although to varying degrees. Sales data was combined with 2016 population data to examine European sales in each country on a per capita basis. Malta, Luxembourg and Bulgaria were found to have per capita sales higher than all other countries. Similarly, per capita sales in Cyprus and Estonia are considerably lower than average.

We believe that it may be worthwhile to examine marketing and sales tactics used in these countries in greater detail. This could provide better awareness of the effectiveness of marketing strategies in different areas, particularly when this information is combined with insights from consumer survey data. This is discussed in more detail below.

Consumer survey data was evaluated using K means cluster analysis in R using the *cluster* and *factoextra* packages. Participants were categorized by nationality and silhouette analysis showed that 4 clusters provided the most appropriate groupings (see Figure 3). Detailed output from the cluster analysis is provided in Appendix A.

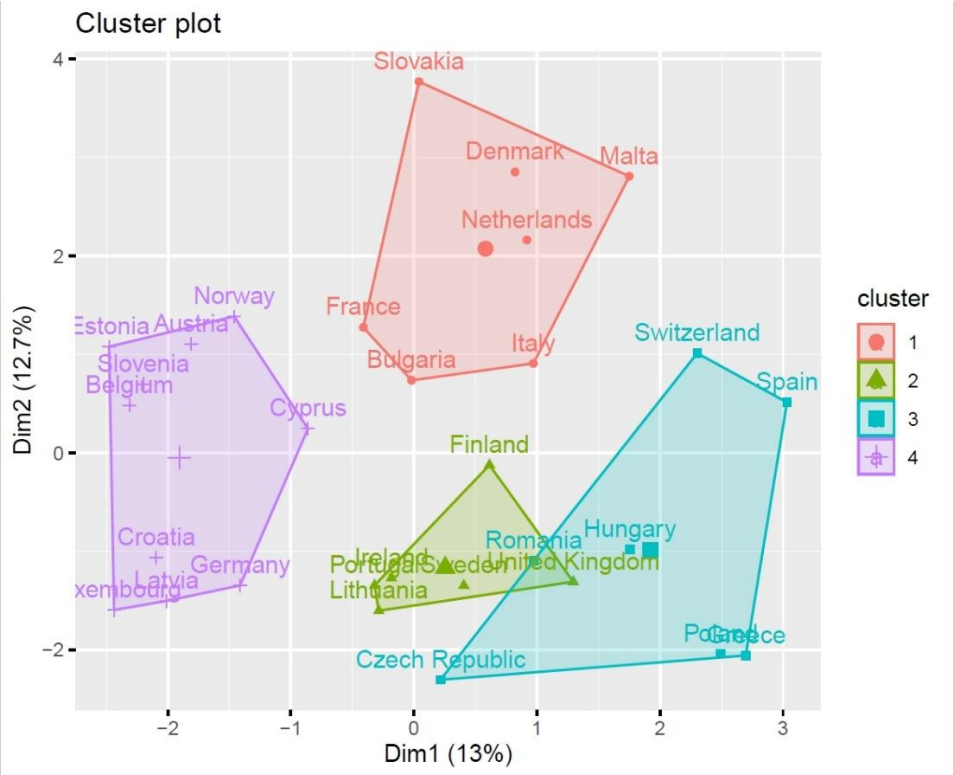


Figure 3 – Customer Survey Clustering Results

We believe this information can be used to determine the phone models and/or marketing tactics that will be most effective in various countries. For example, as noted above, Cyprus and Estonia had lower than average per capita sales in 2016. Both countries are in cluster 4 and survey data indicates that cluster 4 consumers place greater importance on processor speed and speaker quality than other features. Therefore, sales in these countries may be improved by the introduction of Model 10 which offers the highest levels of these features.

Factory Upgrades

To explore what-if scenarios involving manufacturing upgrades, the Product Solver was created in Microsoft Excel. (The Product Solver can be found at https://github.com/mitchb63/ANLT540/blob/main/Product_Solver.xlsx). The Product Solver uses a system model that reflects the current state of Big Tech's production facilities, then allows phone model production constraints to be varied along with constraints on the purchase and implementation of new machinery in Big Tech's factories. Two sets of global production forecasts were created using an exponential smoothing model. One set included introduction of new phone models to the European market and one did not. The Product Solver takes the given constraints and optimizes production of phone models in order to maximize profit. A variety of scenarios were explored where product demand ranged from the lower ranges of predicted values to the maximum predicted levels. Scenarios both with and without the addition of new models to the European market, and with and without plant expansions were evaluated. The following results were found:

No addition of new models in Europe - No plant expansion
Existing facilities can meet up to 88% of the maximum predicted demand.

New models introduced in Europe
Without plant expansion - Existing facilities will only be able to meet 83% of the projected maximum product demand.

With plant expansion - All potential demand is met and overall profits are increased. This is the most profitable scenario but assumes demand will be at the upper end of projected values. In this scenario, $45.85 million in capital improvement expenses will be incurred installing 66 new machines. This results in a profit of $470.5 million compared to $426.7 million under a "no upgrade" scenario that leaves customer demand unfilled. It is worth noting that due to the high labor costs at the Poland plant, it is more profitable to introduce the majority of the plant upgrades in Mexico and Australia. Details for this scenario are provided in Appendix B.

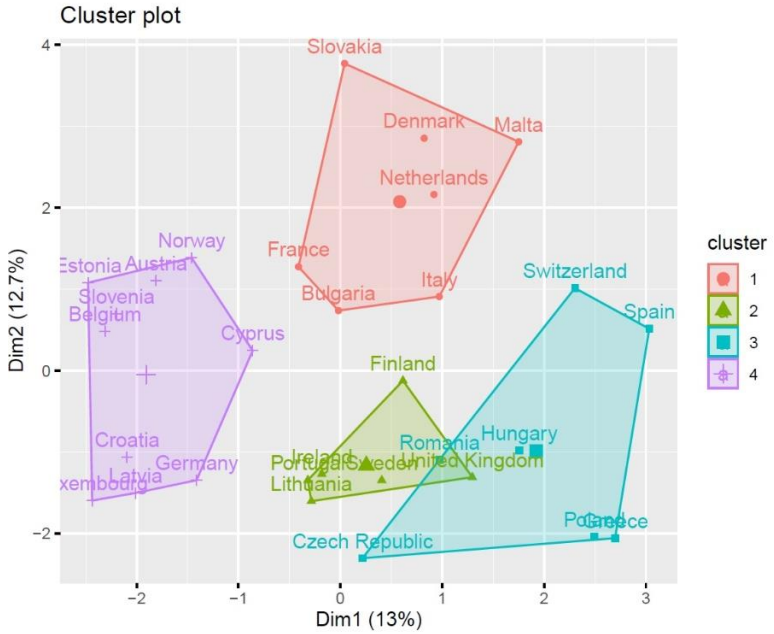
Partnership Opportunities

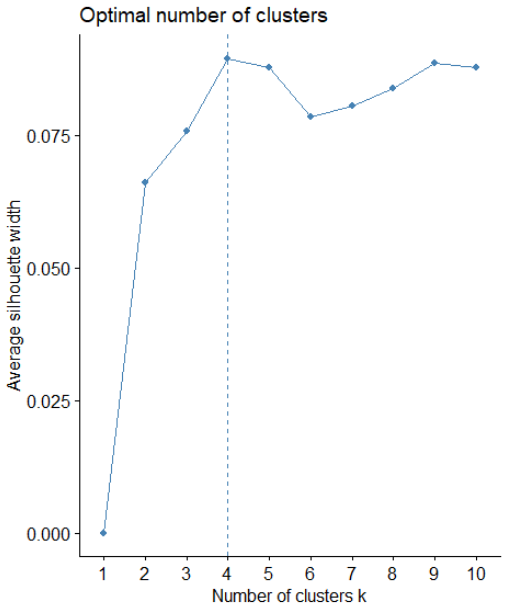
Partnership with Blipper - Big Tech sold 167,210 units to Blipper in 2016 with an overall profit margin of 40.73%. This resulted in $5.97 million in profit. If Big Tech 3 manufactures phones for rebranding by Blipper at an additional 5% margin, profit would increase to $6.7 million (an increase of $0.73 million) on the same sales volume. However, no data exists on projected sales for Blipper branded phones.

Partnership with GMT – An increase of 10% additional market share would amount to $86,729,077. The additional $1.5 per unit takes Big Tech's margin from 31.97% to 30.01%. The 10% increase in production would require the addition of two additional machines at the Poland plant and 3 at the Mexico facility. In this scenario, total net profit is increased by approximately $2.4 million.

While the GMT partnership opportunity appears to be profitable, more information is needed regarding potential sales for the Blipper proposal. Furthermore, potential profit gains from the Blipper proposal appear to be small.

APPENDIX A – CLUSTERING RESULTS FROM CUSTOMER SURVEY DATA



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K-means clustering with 4 clusters of sizes 7, 6, 7, 10

Cluster means:
      Weight Battery_Life Operating_System Speaker_Quality Touch_Screen Processor_Speed        GPS Regional_Global_Service  Bluetooth       Wifi     Hotspot     Camera
1  0.6669224    0.8759072       0.83109351      -0.29460290    0.93298034     -0.1796642 -0.3121353             -1.1037629 -0.2580707  0.4215358 -0.02172652 -0.1738040
2 -0.7363090   -0.5933770       0.13586492      -0.09454824   -0.72199426     -0.1949186  0.4059434             -0.2244809 -0.1002077  0.2421694  0.77665558 -0.4116051
3  0.3474558   -0.5221260      -0.08945265      -0.28210523    0.07713765     -0.5265143  0.9294806              0.5132668  0.8318988  0.2635564 -0.17551590  0.9403954
4 -0.2682794    0.1083794      -0.60066756       0.46042463   -0.27388604      0.6112761 -0.6757077              0.5480357 -0.3415551 -0.6248662 -0.32792366 -0.2896509
  Camera_Quality Camera_Flashlight Front_Facing_Camera Wireless_Charging Cover_Materials Display_Quality Finger_Print_Sensor Touch_Screen_Pressure_Sensor Tilt_Sensor
1     -0.37682615        -0.1701571          -0.4822116        0.11407006     -0.45594350      -0.4762062        -0.01502977                   -0.8622093   0.4548926
2      0.76758467        -0.1662130           0.8940466       -0.06610743      0.78261072      -0.3760089         0.56445775                    0.5497994   0.1777040
3     -0.02736823        -0.3461599          -0.8128344       -0.07819504     -0.29009810       0.9693140         0.80975335                    0.6332570   0.1343825
4     -0.17761473         0.4611497           0.3701042        0.01455194      0.05266268      -0.1195701        -0.89498116                   -0.1696130  -0.5191150

Clustering vector:
       Austria        Belgium       Bulgaria        Croatia         Cyprus Czech Republic        Denmark        Estonia        Finland         France        Germany
             4              4              1              4              4              3              1              4              2              1              4
        Greece        Hungary        Ireland          Italy         Latvia      Lithuania     Luxembourg          Malta    Netherlands         Norway         Poland
             3              3              2              1              4              2              4              1              1              4              3
      Portugal        Romania       Slovakia       Slovenia          Spain         Sweden    Switzerland United Kingdom
             2              3              1              4              3              2              3              2

Within cluster sum of squares by cluster:
[1] 102.3597  88.5927 109.4043 146.7036
 (between_SS / total_SS =  26.6 %)
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APPENDIX B – PRODUCT SOLVER RESULTS FOR NEW MODEL INTRODUCTION WITH PLANT EXPANSIONS

Big Tech 3 Production Optimizer

Instructions: Enter the desired minimum and maximum production constraints in cells L13:L22 and N13:N22 respectively and set the values in cells C8:L10 to 0.
Click Data -> Solver
To optimize production without adding new machinery, and set the Solver Changing Variable cells to "$C$4:$L$6".
To include additional machinery, set the Changing Variable cells to "$C$4:$L$6,$C$8:$L$10".
Click Solve

		Model Production										
		Model_1	Model_2	Model_3	Model_4	Model_5	Model_6	Model_7	Model_8	Model_9	Model_10	Hrs/Wk
New Phones	Poland	0	139062	1296830	3758819	0	0	0	0	0	0	70
	Australia	932256	0	0	15777	0	0	823603	150452	227	773095	70
	Mexico	0	1036282	529734	13267	879669	228139	775949	0	1423366	0	70
		Machine_1	Machine_2	Machine_3	Machine_4	Machine_5	Machine_6	Machine_7	Machine_8	Machine_9	Machine_10	
New Machines	Poland	0	0	0	0	0	0	0	1	0	0	
	Australia	0	16	0	0	0	2	0	0	0	0	
	Mexico	3	28	0	1	0	7	0	4	0	0	

	Machine Hour Constraints				# Mach.	Curr. Mach.
Poland	Machine_1	85780	<=	87360	24	24
	Machine_2	429520	<=	429520	118	118
	Machine_3	105332	<=	112840	31	31
	Machine_4	0	<=	0	0	0
	Machine_5	0	<=	0	0	0
	Machine_6	156520	<=	156520	43	43
	Machine_7	0	<=	0	0	0
	Machine_8	113904	<=	113904	31	30
	Machine_9	0	<=	0	0	0
	Machine_10	35810	<=	36400	10	10
Australia	Machine_1	27637	<=	36400	10	10
	Machine_2	226607	<=	226607	62	46
	Machine_3	28789	<=	32760	9	9
	Machine_4	10733	<=	14560	4	4
	Machine_5	35478	<=	36400	10	10
	Machine_6	29009	<=	29009	8	6
	Machine_7	50960	<=	50960	14	14
	Machine_8	25489	<=	29120	8	8
	Machine_9	2893	<=	3640	1	1
	Machine_10	13128	<=	14560	4	4
Mexico	Machine_1	40361	<=	40361	11	8
	Machine_2	383629	<=	383629	105	77
	Machine_3	41014	<=	61880	17	17
	Machine_4	14234	<=	14234	4	3
	Machine_5	51591	<=	61880	17	17
	Machine_6	25534	<=	25534	7	0
	Machine_7	49072	<=	91000	25	25
	Machine_8	46421	<=	46421	13	9
	Machine_9	0	<=	3640	1	1
	Machine_10	24499	<=	40040	11	11

	Model Production Constraints				
Model_1	932256	>=	479184	<=	932256
Model_2	1175344	>=	800024	<=	1175344
Model_3	1826563	>=	1271933	<=	1826563
Model_4	3787863	>=	2144577	<=	3787863
Model_5	879669	>=	248835	<=	879669
Model_6	228139	>=	170357	<=	228139
Model_7	1599552	>=	520464	<=	1599552
Model_8	150452	>=	78372	<=	150452
Model_9	1423592	>=	756488	<=	1423592
Model_10	773095	>=	432981	<=	773095

Total Profit
$473,170,941

Total Unit Production
12776525

Phone Profits			
	Poland	Australia	Mexico
Model_1	$0	$18,878,186	$0
Model_2	$2,473,917	$0	$24,901,850
Model_3	$37,465,408	$0	$20,447,723
Model_4	###########	$910,478	$803,179
Model_5	$0	$0	$24,674,712
Model_6	$0	$0	$5,607,656
Model_7	$0	$31,716,957	$32,473,463
Model_8	$0	$8,882,673	$0
Model_9	$0	$12,334	$82,242,059
Model_10	$0	$43,587,080	$0

New Machine Cost			
	Poland	Australia	Mexico
Machine_1	$0	$0	$2,464,643
Machine_2	$0	$13,389,874	##########
Machine_3	$0	$0	$0
Machine_4	$0	$0	$610,834
Machine_5	$0	$0	$0
Machine_6	$0	$606,677	$2,160,881
Machine_7	$0	$0	$0
Machine_8	$647,429	$0	$1,880,338
Machine_9	$0	$0	$0
Machine_10	$0	$0	$0