

**Pal-Tech Inc.  
Resource Allocation Model**

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## **Abstract**

Pal-Tech is a small Information Technology support company. In recent months, Pal-Tech was forced to lay off many of its employees. Many employees were shocked and upset and management began receiving numerous complaints regarding the layoffs. Employee morale was down, affecting all aspects of business. Productivity among the workers began to decline and employee resignations began to increase. In an effort to turn things around, Pal-Tech's management has decided to implement various initiatives that aim to improve employee productivity and moral. Pal-Tech will use an Analytic Hierarchy Process (AHP) via Expert Choice software to determine the optimal mix of the workplace improvement projects to be selected based upon the cost and expected benefit of various alternatives.

## ***Company Background***

Planning and Learning Inc. (Pal-Tech) is a small government contracting company based in Rosslyn VA. It specializes in training, technical assistance and the integration of appropriate technological tools and information systems to improve management operations. The company was founded in 1987 to provide quality services that exceed customer expectations. Pal-Tech's philosophy and business practices have resulted in an average annual growth rate of 24 percent since 1997.

Pal-Tech serves U.S. Government around the world in four areas:

- Training Services
- Technical Assistance
- Interactive Technology Solutions
- Outreach and Stakeholder Involvement<sup>1</sup>

Pal-Tech has provided service to the U.S Government for 15 years in more than 50 countries. It's dedicated to achieving complete satisfaction though excellent customer service and the highest ethical behavior.

## ***Goal***

Pal-Tech's goal is to select an optimal mix of workplace improvement initiatives to implement in order to improve worker productivity. The budget for the implementation of worker productivity initiatives is \$100,000.

Upon completion, the model is to be briefed to the head of Pal-Tech's IT department. The IT department head is in charge of procuring internal workplace improvements. It is believed that, upon demonstration, he will see the benefit that Expert Choice provides in resource allocation decision making. He will then implement the optimal solution set the model produces.

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<sup>1</sup> [www.pal-tech.com](http://www.pal-tech.com)

## **Alternatives**

To achieve the goal of improving employee's productivity, the following alternatives were selected by asking the IT department head for some of the solutions he was thinking about implementing. In the following sections of this document, the alternatives are broken down to clarify the specifics of how the alternatives could be implemented.

- Cell Phones
- Computer Upgrade: Notebooks
- Computer Upgrade: RAM & Hard Drives
- New Computers w/ Flat screen Monitors
- New Server
- Extra Support Chairs
- Standard Chairs
- PDA Standard
- PDA Wireless
- Wireless Infrastructure: Access Point
- Wireless Infrastructure: Wireless NICs
- Work Related Training

### ***Cell Phones***

Cell phones were included as one of the alternatives because they provide the ability to communicate among employees and business contacts, independent of physical location. Beyond the typical talking plans, the cell phones will be web-enabled so employees may send and receive emails. Cell phones could be an important addition, as many of Pal-Tech's employees are offsite inside government building, which prohibits personal calls. Employees who use government phones for personal use may be asked to leave the contract permanently. The estimated cost of providing cell phones is approximately \$70 dollars per phone.

Cell phones alternatives are divided into the following 3 groups.

1. Cell Phones: 15 employees
2. Cell Phones: 25 employees
3. Cell Phones: 50 employees

### ***Computer Upgrade: Notebooks***

Laptop notebooks were added as an alternative because they provide employees the ability to be mobile. They allow employees to take their work home, allowing more work to be accomplished.

Computer Notebooks are divided into 3 groups

1. Computer Upgrade: Notebook for 15 employees
2. Computer Upgrade: Notebook fro 25 employees
3. Computer Upgrade: Notebooks for 50 employees

### ***Computer Upgrade: RAM & Hard Drive***

Adding additional RAM and Hard Drives (HD) were included as one of the alternatives because they allow employees to not only have additional storage space, but they also provide the ability to run applications faster. Employees could spend more time doing their work rather than waiting for their computer to respond in a timely matter. Employees could keep more programs open and increase their PCs responsiveness. Each upgrade will consist of a total 1GB of RAM and an additional 100 GB hard drive. Estimated cost to upgrade each machine is approximately \$200.

Computer Upgrade: RAM & HD are divided into 3 alternatives:

1. Computer Upgrade: RAM & HD for 15 employees
2. Computer Upgrade: RAM & HD for 25 employees
3. Computer Upgrade: RAM & HD for all 50 employees

### ***New Desktop Computers w/ Flat screen Monitors***

New computers with flat screens would be a benefit to Pal-Tech's employees, as they would increase desk space. The majority of Pal-Tech' employees are in small cubicles with very limited space. In addition many of Pal-Tech's computers are outdated, and their warranties are going to expire soon.

New computers will increase productivity because of their speed and reliability. Currently, a great amount of time is spent waiting for the IT personnel to fix the machines. With new computers, more time may be spent doing actual work. The estimated cost for a new computer with flat screen monitor is approximately \$1500 per unit.

New computers with flat screen are also divided into 3 alternatives.

1. New computers with flat screen for 15 employees
2. New computers with flat screen for 25 employees
3. New computers with flat screen for all 50 employees

### ***New Server***

Adding an additional server to the network will greatly improve worker productivity with faster application response, faster database query, increased disk storage, and greater redundancy. A new server could also provide room for additional growth. Estimated cost for a new Dell PowerEdge server is approximately \$1000.

### ***Extra Support Chairs***

The extra support chairs alternative was selected because of potential health problems with current chairs. Employees are constantly complaining that their current chairs don't offer any back support. With the extra support chairs the body is in a neutral, stress free

position. The muscles, tendons, and ligaments are supported in complete balance and the vertebrae properly aligned. With these extra support chairs employees can concentrate more on working rather than spending unnecessary time and pain trying to get comfortable in a chair that isn't so. An extra support chair is estimated to be approximately \$200 each.

### ***Standard Chairs***

The standard chairs alternative is an upgrade from current chairs that are currently being used. They provide an armrest that the current chairs do not. The estimated cost for a standard chair is approximately \$100 each.

### ***PDA standard***

A PDA is a handheld computer that provides a calendar and organizer for personal/business information. Providing PDAs to employees will allow them to organize, plan and store data. Users are able to access data easily and quickly. Users may communicate and transfer data between other PDA users as well. The estimated cost for a standard PDA is approximately \$100 each.

### ***PDA wireless***

PDA wirelesses are similar to the PDA standard but with wireless capabilities. Users could send and receive email. PDA wireless users could be linked to the internet to conduct research and could even send faxes. Users could also communicate through popular instant messenger services such as AOL Instant Messenger and Yahoo Messenger. All of these functions could be performed from the palm of their hands. Users would not have to be at their desk to do their job. PDA wirelesses are dependent on the alternative Wireless Infrastructure: Access Point. The estimated cost for PDA wireless is approximately \$400 each.

PDA wirelesses are divided into 3 alternatives.

1. PDA: With wireless for 15 employees
2. PDA: With wireless for 25 employees
3. PDA: With wireless for 50 employees

### ***Wireless Infrastructure: Wireless NICs***

Wireless NICs enable laptop users to roam freely around the office without the need of long messy cables. Users will be able to conduct meetings in conference rooms while having network connectivity. Wireless NICs are dependent upon the purchase of Wireless Infrastructure: Access Point. The estimated cost for each wireless NIC is approximately \$60 each.

Wireless NICs are divided into 3 alternatives.

1. Wireless NICs for 15 employees
2. Wireless NICs for 25 employees
3. Wireless NICs for 50 employees

## ***Work Related Training***

Work related training offers employees the opportunity to attend various work related training (software applications, hardware, and certifications) to provide additional knowledge and expertise.

Work Related Training is divided into 3 alternatives.

1. Work related training for 15 employees
2. Work related training for 25 employees
3. Work related training for 50 employees

## **Objectives**

To achieve the goal of improving employee's productivity, the following objectives were selected as being important to Pal-Tech. The objectives were derived from a member of the IT staff with intimate knowledge of what is valued when procuring solutions for workplace improvement. The objectives are to be used as a means of evaluation to determine the value and benefit that each alternative would provide towards the end goal. Using verbal pairwise comparisons in the AHP Expert Choice software, the objectives were weighted to provide a means of evaluating which alternative characteristics are more important in achieving the goal.

- Reliability- 13.2%
- Saving- 13.2%
  - IT Impact- 1.0%
  - Time-3.8%
  - Dollars- 8.3%
- Convenience- 14.1%
- Morale- 26.3%
- Knowledge Sharing-27.3%
- Risk- 6.0%

### ***Reliability***

The reliability objective is a measure of the extent to which a particular alternative is subject to failure. The higher the reliability of a particular alternative, the higher the assessment will be when evaluating the different options.

### ***Saving***

The saving objective is a measure of the extent to which a particular alternative saves Pal-Tech and its employees a particular resource. Saving was further broken down into IT Impact, Time, and Dollar Saving sub-objectives.

### ***IT Impact***

IT Impact is a measure of the extent to which a particular alternative saves Pal-Tech with respect to the IT department. This sub-objective reflects both the short and long term effort that is saved by implementing a particular alternative.

## **Time**

Time is a measure of the extent to which a particular alternative saves Pal-Tech with respect to time. This time is the time saved by employees doing their work with the alternative implemented as opposed to the current way in which they do business.

## **Dollar**

Time is a measure of the extent to which a particular alternative saves Pal-Tech with respect to money. This is the money that the company saves by implementing the alternative compared to the money currently spent.

## **Convenience**

The convenience of an alternative refers to the ease of implementation. If an alternative can be easily implemented then it would be more preferable than an alternative that would require significant rework.

## **Morale**

The morale alternative attempts to capture the intangible “gee-whiz/coolness” factor of alternative. Certain alternatives could provide Pal-Tech employees with a feeling that the company goes over the top and does more than what is expected so that employees have reassurance that they are a valued member of the company.

## **Knowledge Sharing**

Knowledge sharing is the extent to which a particular alternative helps company employees communicate and share ideas.

## **Risk**

The risk objective attempts to capture the possible negative effect on performance a particular alternative could have, lowering the expected benefit. The higher the risk of an alternative, the lower the assessment the alternative would have in the Expert Choice model.



## **Analytical Hierarchy Process**

Expert Choice Software version 11 was the tool Pal-Tech decided to utilize in order to achieve the goal of choosing the best mix of workplace improvement initiatives. Expert Choice is based on Analytical Hierarchy Process (AHP), which was developed by Thomas Saaty, a pioneer in the Operation Research field. The AHP will help determine the overall goal, while focusing on the main objectives that will meet the goal and rank a set of alternatives for the appropriate answer.

### ***Resource Allocation Model***

In order to achieve a systematic, rational, and defensible allocation of resources that will provide a competitive advantage, the resource allocation model was utilized. It can adapt to a wide variety of situations and constraint. The followings steps were taken to obtain the goal of choosing the best mix of workplace improvement initiatives to implement to improve worker productivity<sup>2</sup>.

1. Identify and structure the organization's goals and objectives
2. Prioritize the objectives and sub-objectives
3. Identify/design alternatives
4. Measure each alternative's contribution to each of the lowest level sub-objectives
5. Find the best combination of alternatives, subject to environmental and organization constraints.

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<sup>2</sup> Forman, Ernest and Mary Ann Selly. *Decision by Objectives*

Figure 1 depicts the structure of the resource allocation model. The objectives and their relative priorities are captured on the left portion of the display, while the alternatives are listed on the right.

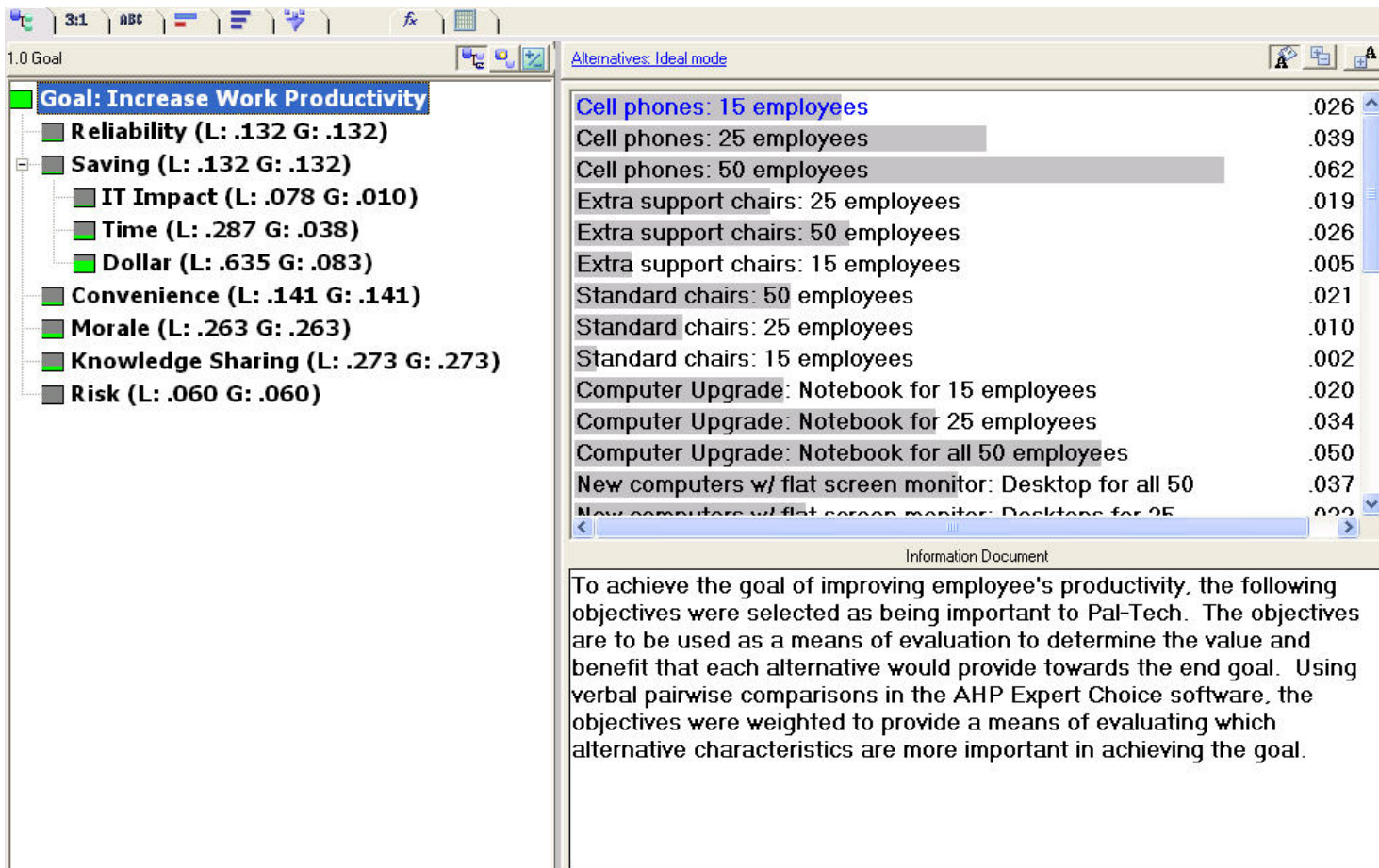


Figure 1. Main AHP model screen displaying objectives, alternatives.

As depicted in Figure 2, the objectives and their respective priorities were obtained through verbal pairwise comparisons. In simple English, this means that the objectives were rated by comparing each objective against all of the other objectives on a nine point verbal scale ranging from “Equal” to “Extreme”.

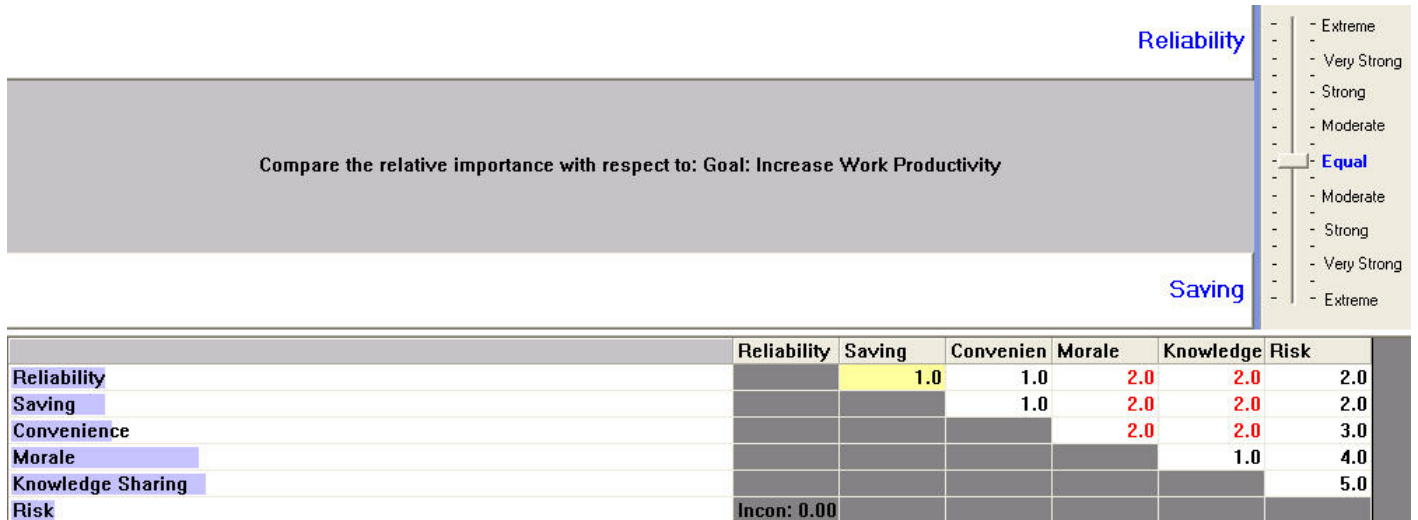


Figure 2. Verbal Pairwise Comparison of Objectives

The Data Grid is represented in Figure 3. Within the Data Grid, cost is assigned to the alternatives.

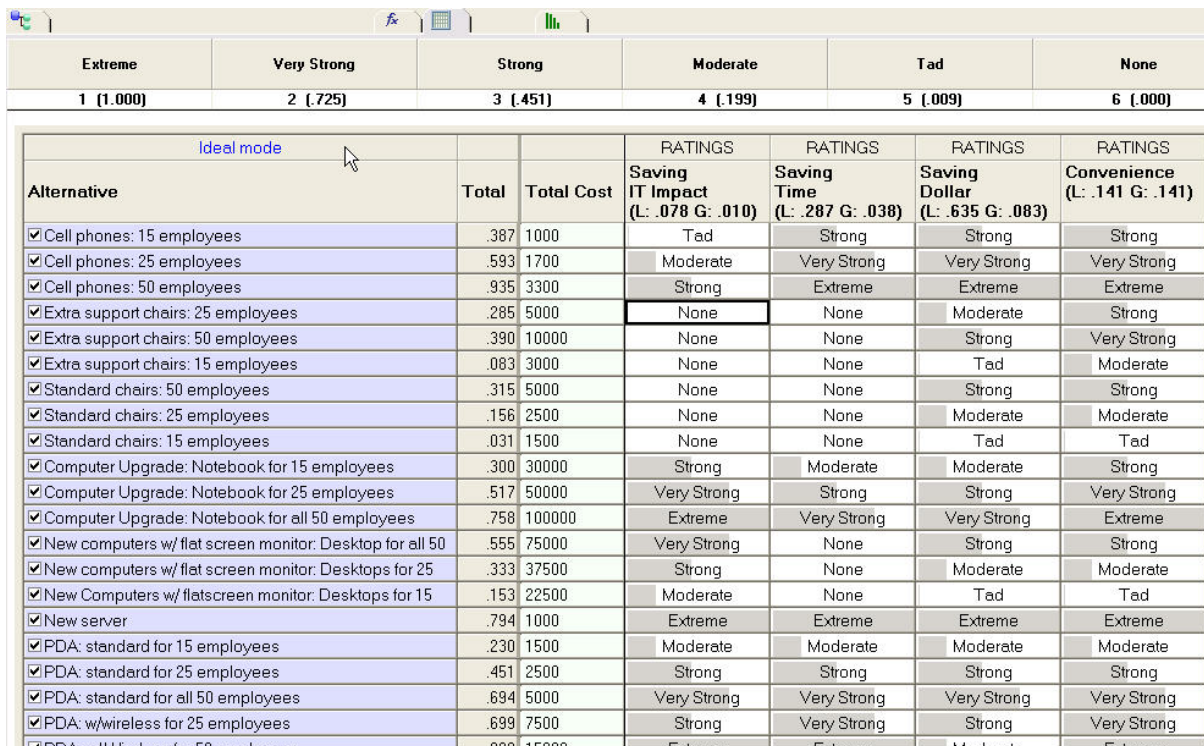
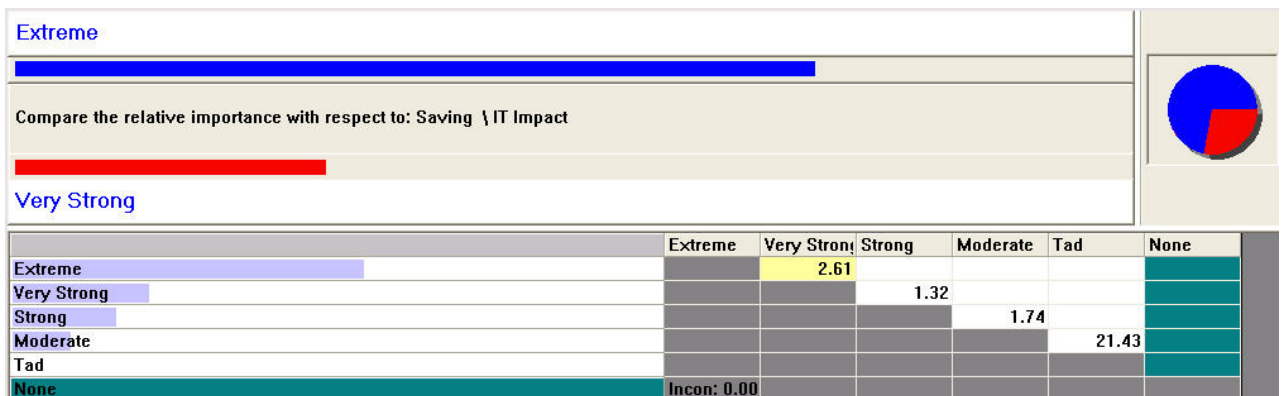


Figure 3. Datagrid

Next, ratings are created and assessed utilizing a graphical pairwise comparison (Figure 4). This type of comparison involves comparing each rating to the next rating in the scale using an easy to gauge bar/pie chart representation. The rating scale includes the following ratings:

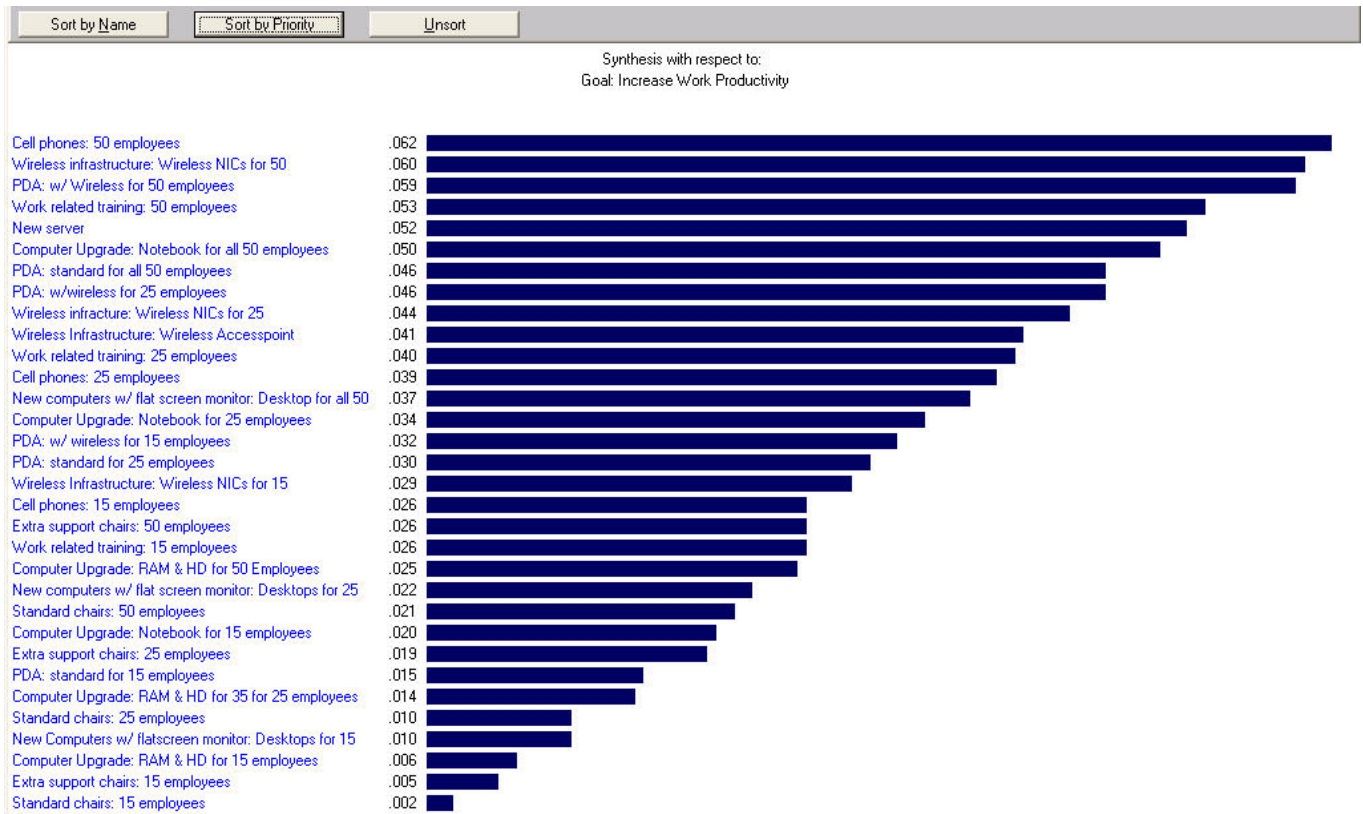
- Extreme
- Very Strong
- Strong
- Moderate
- Tad
- None

Note that on the data grid, the “None” rating is set to equal zero, while the “Extreme” rating is set to one, as it is the highest possible rating. All the other ratings fall between zero and one. Each objective in the model uses the same rating scale to assess the alternatives.



**Figure 4. Rating Scale**

Each alternative is then assessed in the data grid using the derived scales. This measures how well the alternative meets each particular objective. Once the rating of alternatives has been completed, it is possible to synthesize the alternatives with respect to expected benefit. This synthesis, illustrated in Figure 5, shows that Cell Phones for 50 employees, Wireless NICS for 50 employees, and wireless PDAs for 50 employees provide the greatest benefit to increasing productivity, while the standard chairs for 15 employees alternative provides the least benefit.



**Figure 5. Synthesis of Alternatives**

Once the rating of alternatives has been completed the resource aligner, illustrated in Figure 6, is utilized to help determine the optimal mix of alternatives to select. The resource aligner takes into account the \$100,000 budget, customized constraints, alternatives that must be selected, and dependencies among alternatives.



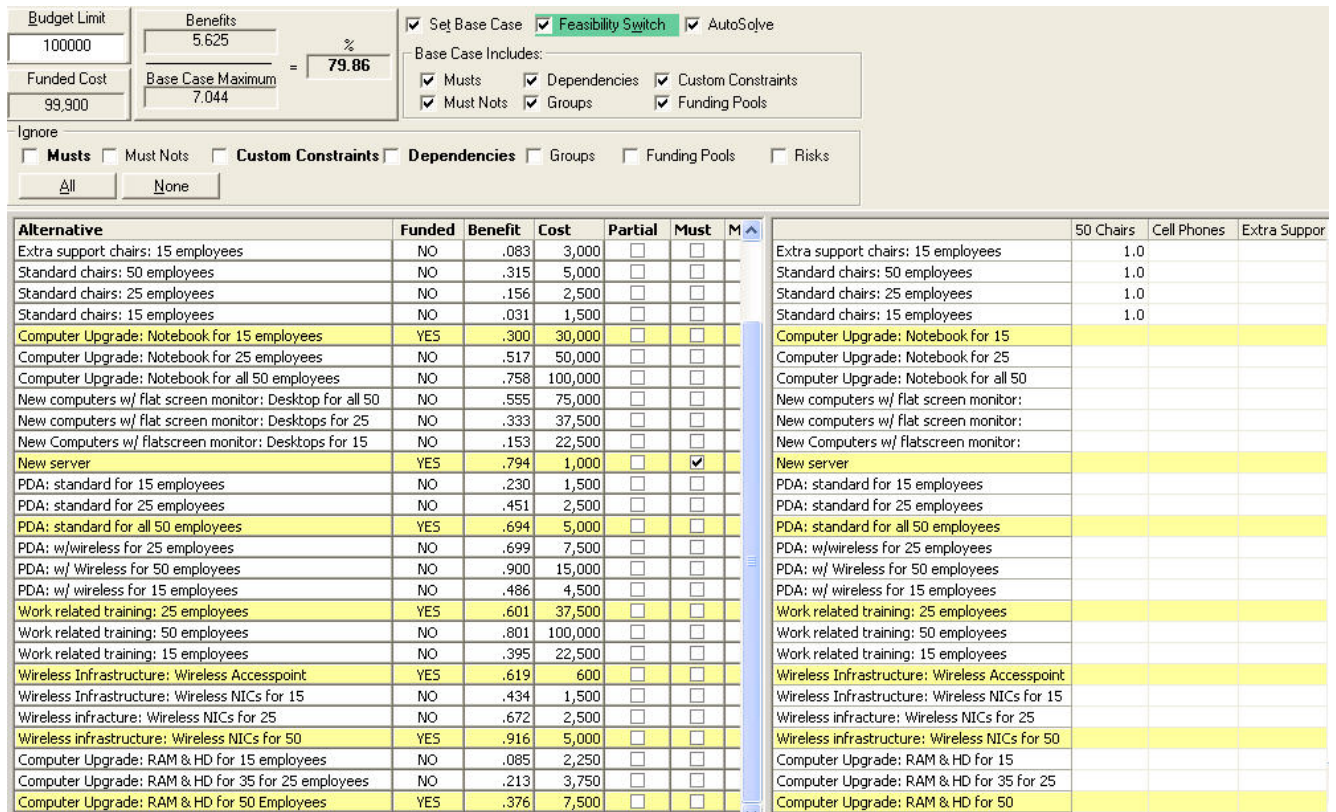


Figure 6. Resource Aligner

From the Resource Aligner, settings are created to directly impact the optimal solution set. For instance, custom constraints are made to create logical scenarios. It would be irrational for Pal-Tech to purchase PDAs for 15, 25 and 50 employees so the constraints make it so that only one of these options may be selected. Furthermore, certain alternatives are required to be in the optimal solution set. Workers at Pal-Tech have been submitting complaints about workstations being too sluggish. To solve this problem, management has decided a new server is required in the optimal solution set.

Though most of the settings that effect the decision can be input directly from the Resource Aligner display, dependencies must be input in a separate Dependency display. Figure 7 depicts how dependencies are accounted for in the Expert Choice application. The display indicates that all wireless PDA options are dependant upon the wireless Accesspoint alternative.

	PDA: standard for all 50 employees	PDA: w/wireless for 25 employees	PDA: w/Wireless for 50 employees	PDA: w/wireless for 15 employees	Work related training: 25 employees	Work related training: 50 employees	Work related training: 15 employees	Wireless Infrastructure: Wireless Accesspoint	Wireless Infrastructure: Wireless NICs for 15
PDA: w/wireless for 25 employees								D	
PDA: w/Wireless for 50 employees								D	
PDA: w/wireless for 15 employees								D	
Work related training: 25 employees									

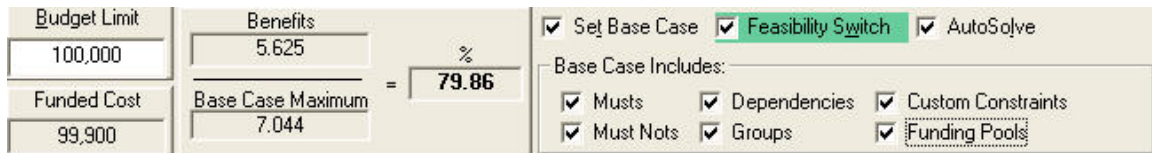
Figure 7. Dependency chart

## Analysis & Recommendations

The Resource Aligner shows that when considering a \$100,000 budget, customized constraints, required alternatives, dependencies, and assessed benefits, the following solution set is the optimal mix of alternatives that should be implemented in order to increase productivity.

- Cell phones for 50 employees
- Extra support chairs for 50 employees
- Laptop computer upgrade for 15 employees
- New Server
- Standard PDAs for 50 employees
- Work related training for 25 employees
- Wireless Accesspoint for wireless infrastructure
- Wireless NICs for 50 employees
- RAM and Hard Drive upgrade for 50 employees

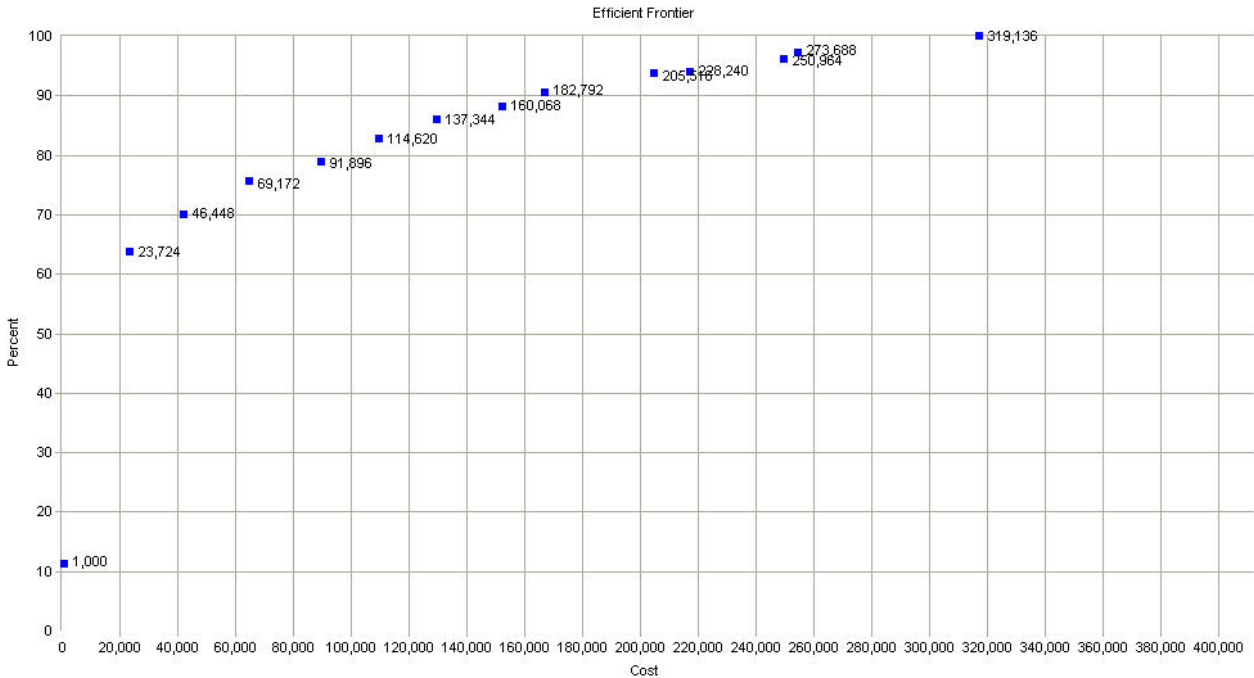
Figure 8, an excerpt from the Resource Aligner display, shows the expected benefit that the above solution set will provide. Of the \$100,000 budget, all but \$100 would be used to implement the alternatives. When all dependencies, constraints, and must-haves are considered in the base, the expected benefit is 79.86% of the maximum benefit that could possibly be attained.



**Figure 8. Expected Benefit**

Figure 9 is a graph that is used to compare expected benefit with increasing or decreasing budgets. The graph shows that in order to reach 100% benefit, the budget would have to be increased to \$319,136. Clearly diminishing returns are present, as it would cost an additional \$219,136 over the budgeted \$100,000 to realize the last 20.14% of benefit. More importantly, this graph shows that if budgets could be increased, it should be increased to no more than \$182,792. At this cost, roughly 90% benefit could be achieved. The additional \$136,344, above the \$182,792, required to achieve 100% benefit is not justified by the minimal amount of benefit received. This is illustrated in Figure 9 as the slope of the graph begins to level out after \$182,792.





**Figure 9. Efficiency Frontier Chart**

As the current budget is set at \$100,000, the solution set defined in the beginning of this section is the optimal solution set that has been recommended to the head of Pal-Tech's IT department. The head of the IT department is in charge of procuring internal workplace improvements and has agreed to consider using Expert Choice's defined solution set when implementing 2005 workplace improvements. Furthermore, the IT department head has commented that, if given adequate time, he would have presented the AHP model to senior management when they were creating department budgets. Perhaps the model could have demonstrated what workplace improvements could be obtained if the IT department were granted a larger budget. Though the model's objectives, alternatives, and budget would have to be updated, a revised AHP may be created for FY 2006 planning and budgeting purposes.

## **Bibliography**

Forman, Ernest and Mary Ann Selly. *Decision by Objectives*

World Wide Web, [www.pal-tech.com](http://www.pal-tech.com)