Strategic Workforce Optimization: Ensuring Workforce Readiness with OptForce™

1. Introduction

CEOs consistently identify "attracting, retaining and developing talent" as a priority, as well as a top business challenge for the future. They recognize that their organization is only as good as its talent, and success depends on having **the right people in the right place at the right time and for the right cost** - a concept we call ***readiness***. Achieving a high level of readiness requires the ability to anticipate and rapidly respond to changing workforce needs, and to allocate resources as effectively as possible in meeting those needs.

While talent is a top priority, few organizations manage it as strategically as they do their financial and physical assets, or their customer requirements. In most organizations, workforce planning is in its infancy, if done at all, and the tools and analytics used to support HR decisions are not nearly as advanced as they are in other disciplines (e.g., there's no equivalent of a cash flow model or operations plan). Yet the complexity of the "task" is enormous! The pace of change within economies, industries and organizations continues to accelerate; labor markets continue to become more competitive and more global; the workforce continues to become more diverse in terms of its demographics, expectations and goals.

Advanced workforce planning and talent management tools are needed to enable HR to:

- Forecast human capital requirements (numbers, skill sets, locations, timing) given a range of possible business scenarios, and respond in real-time to changes in the assumptions behind those scenarios;
- Identify the recruitment channels that will be most effective in meeting those requirements;
- Forecast the impact of various HR programs/practices on attraction and retention, and identify how that varies based on demographics, job level, and performance;
- Model the impact of turnover and employee movement within the organization;
- Understand trade-offs between readiness and HR costs;
- Achieve objectives with respect to workforce representation;
- Quantify the financial impact of HR decisions.

Bottom line, if HR is to have a credible place at the strategic planning table, then human capital recommendations and decisions must be made based on data and analytics instead of relying solely on anecdotes and assumptions.

Simulation and optimization technology has been around for a long time in some disciplines and it is an emerging best practice in others. Organizations use it to manage risky portfolios of projects and securities, optimize their business processes, and develop new products and services, among other uses. Organizations that are willing to apply this level of rigor to their human capital decisions will create a distinct competitive advantage.

OptTek, a pioneer and leader in the field of optimization for simulation, recognized the possibilities for human capital decisions when they deployed their optimization technology to manage career progression in the US Navy. The firm set out to develop a model that would enable organizations to optimize readiness (right people, right place, right time, and right costs) and representation (diversity of the workforce) within defined constraints (e.g., HR budget dollars, total compensation dollars, scarce skills.) The National Science Foundation recognized the potential application of optimization to human capital decisions and provided a grant to support development of a prototype. The result is OptForce™.

OptForce, OptTek's strategic workforce planning system, goes beyond traditional workforce planning. Whereas traditional approaches limit their scope to projecting future workforce requirements based on static assumptions, OptForce provides decision making tools that support the development and implementation of strategies, programs and policies to meet those requirements.

Think of HR budget dollars allocated to buckets representing specific practices (policies, programs, initiatives, organizational culture) used to attract and retain valued employees. Then, envision a dial beneath each bucket. You can turn the dial to increase or decrease the resources allocated to each bucket until you find the allocation of resources that is most likely to enable you to achieve specific goals (e.g., attraction, retention, readiness, and representation), recognizing constraints and considering the demographics of your population.

That is just one example of how the decision-making technology within OptForce can be used. Other OptForce applications include, but are not limited to:

- Identifying the most effective recruiting channels for the organization;
- Modeling the cost-effectiveness and risk of using contingent versus regular staff;
- Supporting the budgeting process by defining and communicating trade-offs between readiness and costs;
- Modeling the likely impact of total compensation strategies;
- Identifying likely bench strength in key areas given workforce mobility;

- Modeling workforce requirements and transitions following M&As.

Ultimately, we believe OptForce can be applied to any strategic human capital decision-making process.

2. OptForce: Strategic Workforce Optimization

In order to use OptForce, an organization must begin the process of developing strategic workforce forecasts (in terms of numbers, skills, demographics, locations, timing) linked to business plans and financial and operational forecasts. OptForce then models the movement of people into, within, and out of the organization, factoring in employee attributes such as skill and performance data, information on the current and potential practices that impact attraction, retention and movement, and economic or environmental factors that will impact the business and/or workforce. The outcome of the process is a set of gaps between actual workforce and forecasted workforce requirements. A decision-making optimization-based model is then developed that enables you to evaluate the effectiveness of various strategies in closing those gaps. The components of OptForce are described in more detail in the remainder of this paper.

2.1. *Workforce Forecasting*

Some organizations have already taken the first step in effective workforce planning: forecasting workforce demand. These organizations have developed a model that predicts future workforce requirements based on business planning assumptions. If so, the existing workforce forecast is fed directly into OptForce. If not, OptTek's HR and optimization experts will lead the organization through the process of translating business plans into workforce requirements.

2.2. *The Workforce Planning Model*

The workforce planning model in OptForce is based on an agent-based simulation model. In the model, individual employees are simulated as "computerized agents" that interact with their environment and periodically make decisions about their career in the organization. (The agent-based simulation looks at individual employees in the abstract, not by name.) These decisions are based on their perceptions of the degree to which the organization is currently meeting its objectives and needs, and the likelihood it will in the future.

In OptForce, these perceptions are defined by the organization's practices (e.g., policies, programs, initiatives, work environment) and current and future job opportunities. It considers their probabilistic impact given specific employee attributes. Every period, each employee will make a decision (according to a probability) of whether s/he will stay in the organization for another period, and the organization will make decisions (again, probabilistically) about the assignment of employees to particular jobs, the promotion and movement of employees, and the recruitment of

new hires to fill available positions. The organization will also make decisions about which practices to start, enhance, reduce and discontinue.

Working with OptTek, users will define the optimization objective, i.e. what goal the model will optimize (typically related to readiness, cost, diversity representation, etc.), and other key measures of success. We will also define a set of parameters that govern the simulation, including length of the planning horizon, the practices to be included in the simulation, changes in business strategy/priorities and environmental factors (e.g., economic outlook, talent availability, business outlook) that need to be factored into the simulation, and constraints (e.g., budget limitations.) The output of each simulation is a set of metrics that relate to goal achievement.

2.3 Optimizing the Model

It would be virtually impossible to attempt to simulate every possible combination of inputs to the model. Therefore, we need a procedure that can efficiently guide the search for the set of decisions that will yield the optimal results.

OptForce's embedded optimization software -- OptQuest® -- contains state-of-the-art algorithms for optimizing complex systems, such as workforce planning. OptQuest, a general optimization engine, is based on more than 50 years of combined research by OptTek's staff. Currently embedded in more than 95% of all commercially available simulation software, OptQuest is flexible enough to accommodate single or multiple optimization objectives, as well as various organizational structures, policy/program portfolios, and environmental influences.

2.4 A Simple User Iinterface

OptForce provides a simple, step-by-step user interface that structures the planning process. The software is a tool for senior decision makers, who will not have the time to learn a complicated system. It is very intuitive, and enables the user to focus on useful information versus complex data. In many cases, OptForce will be delivered through a web interface deployed through a software-as-a-service (SAS) sales model.

3. Building the Agent-Based Simulation Model

The basic steps in building the model are:

1. Define workforce forecasts
2. Define key attributes most relevant to categorizing employees (e.g., gender, ethnicity, age, job level, performance rating, etc.)
3. Identify current and proposed HR policies, programs and initiatives designed to influence employee attraction, retention and movement within the organization
4. Determine the impact of each policy, program and initiative on employees with different attributes
5. Define current and potential recruitment channels and practices

6. Define assumptions with respect to promotion and movement within the organization

OptTek's HR and optimization experts guide the user through each step. They provide tools and templates for data collection, external data (where publicly available) to support model assumptions (e.g., correlation between a specific practice and the corresponding retention rates based on demographics), recruiting channel effectiveness in recruiting employees with specific attributes, guidance in determining relevant inputs to the model, and seasoned judgment in the formulation of components of the model which are more subjective, either by nature or due to the lack of historical data when the model is first developed.

3.1. *Define Workforce Requirements*

As described in Section 2.1, defining future workforce requirements serves as the foundation for effective workforce-planning – a forecast of talent requirements given likely business scenarios. It involves translating your business plans into a specific workforce profile or staffing plan -- # of positions, types of skills, timing, location, etc. – and identifying those factors that could change the required profile so that contingency plans can be developed.

Ideally, the organization has done workforce planning on some level. If this is not the case, OptTek modeling specialists will work with you to translate business plans into workforce profiles. The sophistication of the model will depend on the specificity of business assumptions (e.g., is there a direct relationship between revenue/volume and headcount requirements? What productivity improvements are anticipated? Will a change in business direction require different skills?) It may be appropriate to start out with a relatively simplistic planning process and build sophistication over time.

The second component of this step is defining specific job requirements (e.g., knowledge/skills/abilities, education and experience, certifications.) The requirements are likely available in existing job descriptions or job postings.

Table 1 shows sample workforce requirements for an engineering services company.

Column 1 contains the different job categories (i.e. job families, job types, roles, etc.) to be included in the workforce planning simulation.

In our example, Columns 2 through 5 contain the minimum job requirements that an employee must meet in order to be qualified for that job category. The number and type of requirements will depend on each organization, and the software accommodates any combination. The precision of the model will depend on the level of detail in specifying job requirements and employee attributes that relate to job requirements.

Table 1: Sample Workforce Requirements

	Job Requirements						Quantity Required				
Job Category	Job Level (Progression)	Job Type (Skills)	Tenure (Yrs)	Education	Assignment Value	Avg. Annual Salary	Period 1	Period 2	Period 3	Period 4	Period 5
SrProjectManager	Middle Management	Technical	5 - 10	Masters	15	90,000	32	33	34	33	32
JrProjectManager	Non-managerial	Technical	0 - 4	Bachelors	8	60,000	79	82	85	83	81
SrCivilEngineer	Middle Management	Civil	> 5	Masters	15	75,000	32	33	34	33	32
SrConstrEngineer	Middle Management	Construction	> 5	Masters	15	70,000	32	33	34	33	32
SrEnvEngineer	Middle Management	Environmental	> 5	Masters	15	85,000	32	33	34	33	32
SrMechEngineer	Middle Management	Mechanical	> 5	Masters	15	80,000	32	33	34	33	32
SrProcessEngineer	Middle Management	Process	> 5	Masters	15	75,000	32	33	34	33	32
SrElecEngineer	Middle Management	Electrical	> 5	Masters	15	85,000	32	33	34	33	32
JrCivilEngineer	Non-managerial	Civil	0 - 10	Bachelors	9	48,000	63	65	67	65	63
JrConstrEngineer	Non-managerial	Construction	0 - 10	Bachelors	9	45,000	53	55	57	55	53
JrEnvEngineer	Non-managerial	Environmental	0 - 10	Bachelors	9	48,000	58	60	62	60	58
JrMechEngineer	Non-managerial	Mechanical	0 - 10	Bachelors	9	50,000	68	70	72	70	68
JrProcessEngineer	Non-managerial	Process	0 - 10	Bachelors	9	50,000	42	43	44	43	42
JrElecEngineer	Non-managerial	Electrical	0 - 10	Bachelors	9	60,000	42	43	44	43	42
Technologist	Non-managerial	Technical	> 0	Bachelors	1	65,000	31	32	33	32	31
Technician	Non-managerial	Technical	0 - 10	Bachelors	1	45,000	31	32	33	32	31
SrScientist	Middle Management	Technical	> 5	PhD	12	85,000	21	21	21	20	19

Column 6 is used to assign a priority to each job category. This priority reflects the relative importance of filling that position, either internally or by recruiting a new employee. In other words, a job with a higher value will be given priority over one with a lower value if and when the two jobs are competing for resources (i.e. budget). While it is important to fill all jobs, the importance rating enables the organization to prioritize mission-critical positions.

Column 7 contains the salary range minimum, average salary, or another proxy for average hiring rate for each job. The model uses this information to estimate new hire salaries.

Columns 8 through 12 contain the estimated quantity requirements for each category during upcoming periods. Planning can be done on a quarterly, biannual or annual basis.

The workforce requirements model will drive a critical aspect of the planning process, in that readiness will be measured as the extent to which the defined job requirements are met. Therefore, the model will drive job assignments, promotion and other internal movement, and hiring decisions during the simulation of each scenario.

3.2. *Define the key attributes most relevant to categorizing employees*

The second step is to identify the key employee attributes you want to consider in the model. *Attributes* describe the characteristics of an employee, such as age, gender, ethnicity, work experience, education, performance or talent review rating, etc. Attribute *values* are used to classify employees for the purpose of assessing the impact of different HR decisions on different groups of employees. For instance, we may want to track employees by two attributes: *Gender* and

Age. Then, within *Gender* we have two values: *Male* and *Female*; and within *Age* we have four values: *Veterans*, *Baby Boomers*, *Generation X* and *Generation Y*. As an example, if the organization were to implement a policy that allows for flex-time, we would predict a highly positive impact on the retention rate of *Female*, *Generation Y* employees, whereas we would expect little or no effect on the retention of *Male*, *Baby Boomers*.

Ultimately, the set of attributes chosen to describe the employee population should be selected according to the following criterion: *Does the impact of any of the current or potential practices vary significantly by this attribute?* If the answer is "*yes"*, then the attribute should be included in the model.

3.3 Identify current and potential HR practices

The next step is to develop a comprehensive inventory of practices currently in place that impact attraction, movement and retention, as well as any proposed modifications to current practices, and any practices being considered for future implementation. To aid in the process, OptForce provides an interface that organizes practices into different user-defined *Attraction and Retention Drivers*. These drivers represent key factors that affect employee decisions to join an organization or to leave the organization. The drivers that have been reported in the literature to hold the most sway over employee attraction and retention[1] have been included in our model by default. These are (a) *Compensation*, (b) *Benefits*, (c) *Career Development Opportunities*, (d) *Work-Life Balance*, (e) *Manager Quality*, (f) *Company Reputation and Performance, and* (g) *Company Culture and Work Environment.* These Drivers can be modified to reflect any categorization scheme used by the organization.

3.4 Determine the impact of each practice on employees with different attributes

The impact of each practice on an employee's behavior is determined based on relevant employee attributes. In the absence of solid historical data and/or external benchmark data, we assume the organization has, at minimum, anecdotal data and informed judgment as to the expected impact of different practices on employees with specific attributes. Like the development of the workforce profile, this is an area where it may be wisest to start simple and build sophistication over time.

3.5 Define current and potential recruitment channels

In addition to considering the impact of various HR practices on current employees, OptForce considers the effectiveness of alternate recruiting channels in bringing employees into the organization. For each current and potential future recruiting channel, the following parameters are defined:

[1] Compiled from Watson Wyatt webcast: "Advanced Workforce Planning: Securing the Future," *Human Capital Institute,* November 20, 2008; and "Customizing the Employment Offer," *CLC Solutions,* Corporate Leadership Council, Washington, D.C., December 2002.

- A probability distribution of the population in that channel, as defined by key employee attributes
- A cost-per-hire figure for that channel by job level
- An effectiveness factor for that channel by job level
- A maximum number of new hires that can be obtained from that channel, by job level

OptForce is populated with available published data on common channels (e.g., universities, job sites, etc.), but parameters related to effectiveness and cost will vary by organization, so the model will be enhanced by historical, company-specific data.

The probability distribution of the population in a channel represents the likelihood that a new hire will have certain desired attributes. For example, according to the National Center for Education Statistics[2] of the Department of Education, the probability distribution of the population of graduating seniors in all public colleges and universities in the US, by ethnicity and gender, is:

- White males: 29%
- Minority males: 13%
- Asian American males: 3%
- White females: 36%
- Minority females: 16%
- Asian American females: 3%

These data could be entered into a recruitment channel labeled "General Colleges and Universities", so that during a simulation, when a new hire is drawn from this population the likelihood of hiring a minority female, for example, would be about 16%.

The cost-per-hire figure for the channel is the average amount it costs the organization to hire a new employee utilizing that particular channel. It includes all costs and expenses related to hiring, including setup costs (i.e. travel costs to a university, setting up a booth at a job fair, etc.), advertising costs, recruiting costs (i.e. recruiters' time, managers' time in interviews, etc.), agency fees, employee referral fees, relocation expenses, signing bonuses, etc. If the organization doesl not calculate cost-per-hire for each channel, but has a good estimate of average cost-per-hire by job level (e.g., hourly, professional, middle management) each channel's cost-per-hire figure will be derived by multiplying the cost-per-hire times the effectiveness factor, described below.

The effectiveness factor relates to the efficiency of the channel in yielding qualified candidates for a given job family or level. It is multi-dimensional, and can consider such factors as % of jobs filled by this channel, offers as a % of interviews, first-year retention rates, offer acceptance rate) Effectiveness can be measured in many ways, but it is important that the calculation be consistent across all channels.

[2] See http://nces.ed.gov/

Finally, the organization estimates the maximum number of new hires it expects to get from each channel, for each job family and/or level, during each period. Ideally, this information will be forecast based on historical recruitment data, adjusted to reflect expected future state, but it may be based simply on the best judgment of in-house recruiting experts.

The data in the recruitment channels will be used to simulate new hires coming into the organization, according to alternative recruitment budget allocations across channels and the probability distributions of the population associated with each channel.

3.6 Define assumptions with respect to promotion and movement within the organization

The last step in setting up the model relates to the mobility of employees within the organization, in terms of promotions, job changes, location changes, etc. One of the attributes associated with each employee (see Section 3.2 above) is their level within the organization, which may be defined either generically for the entire organization or as defined career paths within a job family. Using historic data on mobility, we develop a probability table as shown in Table 2. This table predicts the likelihood that employees with particular combinations of attributes will move within the organization during the measurement timeframe.

Table 2: Promotion/Advancement rates

Tenure	Job level	Performance rating	Probability
< 5	Non-managerial	Above	0.1
< 5	Middle Management	Above	0.2
6-15	Non-managerial	Average	0.1
6-15	Non-managerial	Above	0.25
6-15	Middle Management	Average	0.2
6-15	Middle Management	Above	0.3
> 15	Non-managerial	Average	0.1
> 15	Non-managerial	Above	0.25
> 15	Middle Management	Average	0.2
> 15	Middle Management	Above	0.5

Table 2 shows an example of a Mobility Probability Table for an engineering services company. In this example, employees are described by tenure, job level, and performance rating, and a movement probability is assigned to each employee with a distinct combination of employee attributes, as shown in the last column. The probability represents the likelihood that an employee with the attributes shown in the first 4 columns will change jobs or locations during the upcoming period. These data will be used to simulate promotion/advancement and internal transfers of employees through the organization.

4. Simulation of workforce planning scenarios:

What-if analysis

Once OptForce has been populated with the data described above, different decision scenarios can be tested. The purpose is to predict the outcome of various HR decisions. These decisions relate to:

(1) *Changes in HR practices*
Assuming a limited HR budget, the organization must prioritize the practices it will implement, maintain, change or discontinue, and the level of funding for each. A key application of the model is to determine the budget allocation that results in the highest possible level of readiness while meeting defined representation goals.

It should be noted that the model considers the existence of various practices and level of funding. It does not attempt to quantify quality of execution. OptTek HR experts can assist organizations in understanding "best practice" and assessing current practices.

(2) *Allocation of recruitment budget*
The model considers how budget dollars are allocated across recruitment channels in simulating movement into the organization. Another key application of the model is to determine the budget allocation that will most likely enable the organization achieve readiness and representation/diversity goals

(3) *Economic/business outlook and other environmental parameters*
Factors such as economic forecasts, the unemployment rate, financial strength of the organization, demand and supply gaps for certain skills, etc. affect employee decisions about staying in a job or seeking other employment opportunities. How this factor is defined will likely be unique to each organization, depending on the factors that are most relevant to their organization and the degree to which these factors can be based on quantitative metrics or are more subjective.

Figures 1 through 3 show comparisons between different scenarios where we have varied one or more of the decisions described above. Scenario 1, which is denoted as the ***Base Scenario***, refers to the situation where the organization continues to conduct "business as usual"; in other words, no new HR practices are added or modified, and investment in current recruitment channels remains the same. The second scenario, denoted ***What-if,*** represents the case where the user has manually changed certain decisions to add or modify an HR practice, or to reallocate recruitment investments. The third scenario, denoted ***Optimized,*** refers to the solution found by OptQuest to be the best solution, as is described in Section 5 of this article.

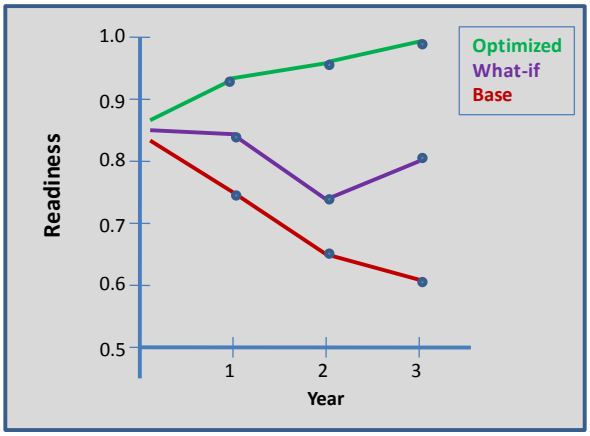

Figure 1: Readiness results under three different workforce planning scenarios

As you can see from Figure 1, although the starting readiness level is about 85%, both the base and the what-if scenarios perform poorly in terms of readiness (reaching levels of 60% and 83% at the end of Year 3, respectively), while the optimized scenario results in an increased readiness level to 97% at the end of Year 3.

In Figure 2, we show the trend in external hires.

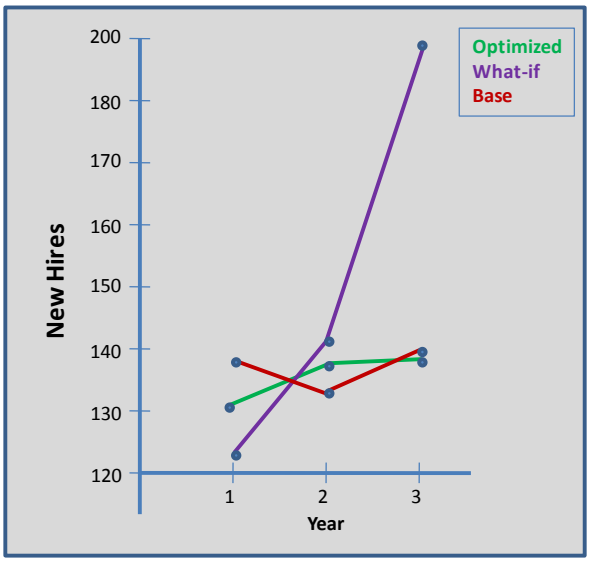

Figure 2: Trend chart of new hires under three different workforce planning scenarios

In the ***Optimized*** scenario, we observe a small upward adjustment from 131 new hires in Year 1 to 137 new hires in Year 2, in order to account for initial turnover. The trend then becomes stable at 137 new hires in Years 2 and 3. However, since turnover is much higher in the ***Base*** and ***What-if***

scenarios, the necessary adjustments are larger, and the number of new hires each year is unstable. The ***Base*** scenario requires 137 new hires in Year 1, 133 in Year 2, and 138 in Year 3; the ***What-if*** scenario requires 122 new hires in Year 1, 142 in Year 2, and 196 in Year 3.

The analysis of new hires is not complete unless we also analyze the composition of turnover. By choosing the correct set of HR programs and practices, the ***Optimized*** scenario improves retention of the right kind of employees, described by a certain type of attributes. Say, for example, that the organization wants to encourage female employees to stay; then, the organization would be interested in investing its budget in programs designed to increase the probability of retention of female employees, such as a comprehensive healthcare program. Such a program would also increase the probability that other types of employees will stay, but its impact on female employees may be higher. Then, when looking to hire new employees, it would be much easier to reach the desired levels if turnover of female employees were lower to begin with. See, for example, Figure 3, where we chart the trend in female employees for three years. In the ***Base*** scenario, we see the number of female employees decrease steadily if the organization continues with its current HR programs as implemented. In the ***What-if*** scenario, we have specifically chosen certain programs designed to reduce turnover of female employees; however, it takes two years for the downward trend to be overturned, because the hurdle that has to be overcome through hiring is large. This can be explained by considering that, given budget restrictions, the programs chosen under the *What-if* scenario do not produce the biggest impact per dollar invested. On the other hand, the ***Optimized*** scenario shows an increasing trend in the number of female employees from the start. This is because, under this scenario, the investment in HR programs is chosen to produce the greatest impact in terms of the goal of female retention. This is analogous to the financial arena, where an investor seeks a portfolio of securities that results in the highest return for a given cost.

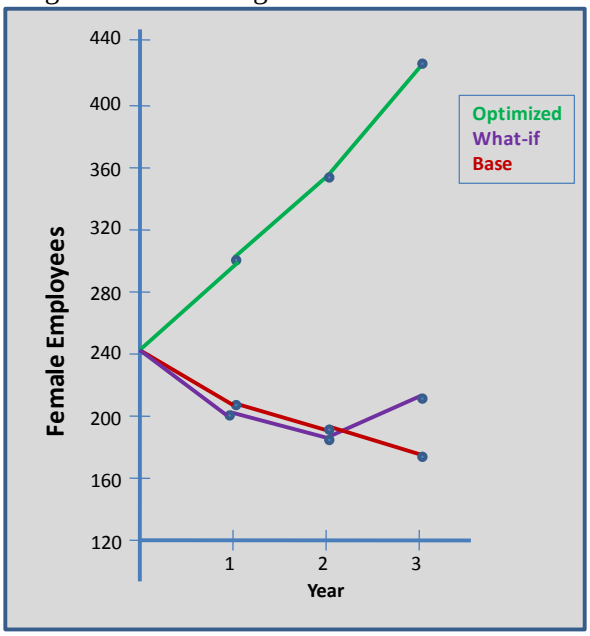

Figure 3: Trend in female employees under three different workforce planning scenarios

The Simulation Process in Action

Figure 5 provides a graphical representation of OptForce's workforce simulation process. The simulation process is modeled across a defined number of measurement periods which may be expressed in months, quarters, years, etc. During each measurement period, the following steps occur:

1. Each employee makes a decision whether to stay or leave the organization. This decision depends on the employee's retention probability, which is computed from the impact of the HR programs in place, given the employee's unique combination of attributes.
2. Once all employees have made a decision, employees who remain in the organization are assigned to available jobs, according to the match between employee attributes and job requirements.
3. Remaining jobs are filled by employees who have a high probability of mobility/promotion and whose attributes match the requirements of the target job.
4. New employees are recruited from the appropriate recruitment channels to fill available jobs, as long as the budget allows for the additional recruitment.

To illustrate these steps, consider the example depicted in Figure 5. In the figure, circles represent employees and rectangles represent jobs; blue represents executive level employees, red represents middle management and green represents non-managerial level employees. Finally, yellow circles represent external hires. In this example, the employee decision and job assignment process is done every year, for three years.

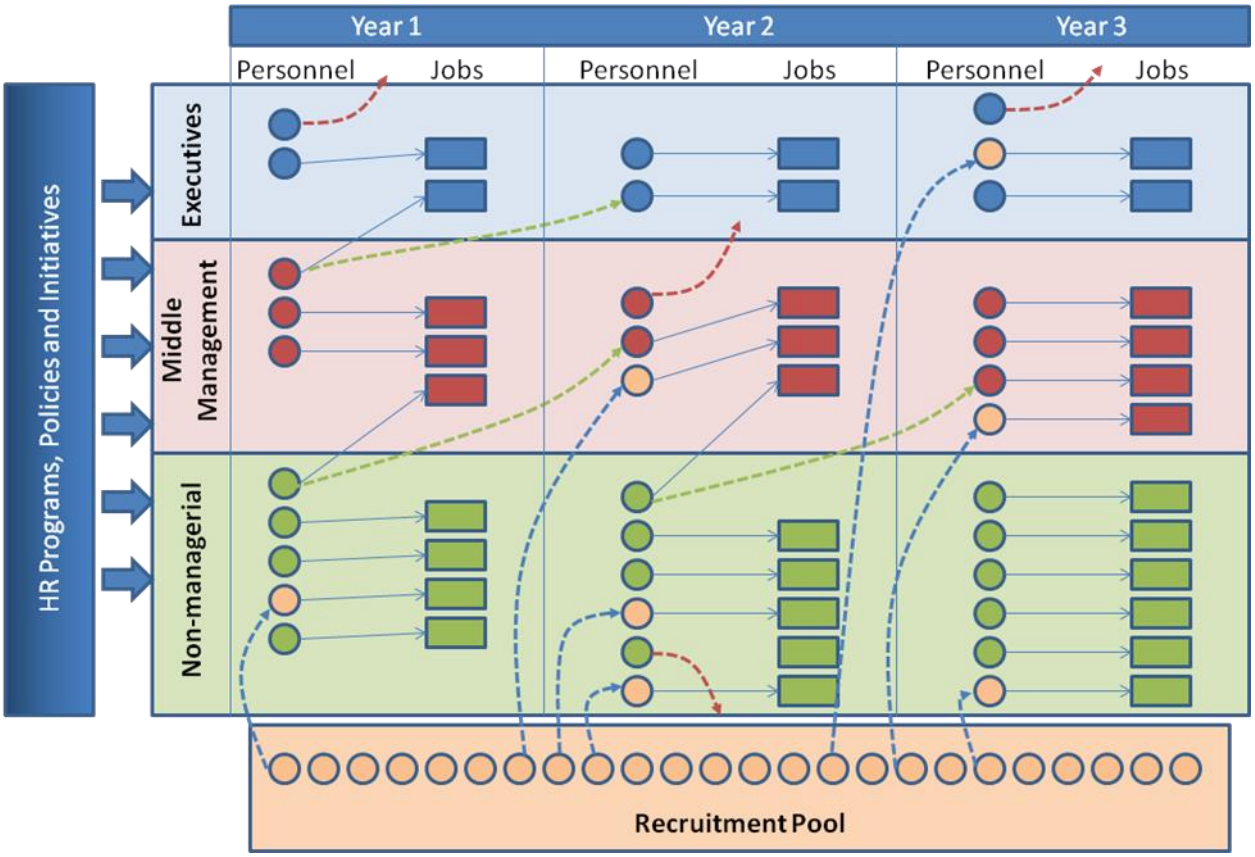

Figure 5: Representation of the OptForce Simulation Process

As Figure 5 shows, the initial workforce is composed of two executives, three middle managers and four non-managerial employees. However, during the first year, one executive leaves the organization, as depicted by the dashed red arrow. The remaining employees are assigned to available jobs. In addition, one middle manager is promoted into an executive level job and one non-manager is promoted into a middle management job, as depicted by the dashed green arrows. Finally, a new employee is hired to fill an available non-managerial position.

During Year 2, one middle manager and one non-manager leave; one non-manager is promoted into a middle manager job; and three new employees are hired. During this year, an additional non-managerial job is created, but remains unfilled due to lack of budget.

During Year 3, one executive leaves; there are no promotions; a new middle management job and a new non-management job are created, requiring three new employees to be hired.

The calculation of retention probabilities is a core component of the simulation. The following describes how retention probabilities are calculated.

Retention Probabilities

We begin with a matrix that relates HR programs to retention drivers. An "X" in a matrix cell means that the program is linked to a driver; in other words, that program, if implemented, supports the appropriate driver. Table 3 shows a sample matrix of HR programs and retention drivers. Note that a program may be linked to one or more retention drivers, and all options of a particular program are linked to the same driver(s).

Table 3: Sample matrix of HR programs and retention drivers

	Education Program		**Flexible Workplace**			**Etc …**
Program/ Driver	**No Tuition**	**50% Tuition**	**No Flexibility**	**Flexible Start Time**	**Telecom muting**	**Etc …**
Compensation						…
Benefits						…
Career Development	X	X				…
Work/Life Balance	X	X	X	X	X	…
Manager Quality						…
Company Reputation						…
Company Culture	X	X	X	X	X	…

Now we look at each employee, described by a set of unique attributes. An example of an employee appears in Table 4. The impact of different HR programs on each employee depends on the combination of attributes; for example, the importance that an employee will place on the availability of a retirement plan will be different depending on the employee's age, tenure, and job level.

Table 4: Sample employee described by a set of unique attributes

Ethnicity	**Gender**	**Age**	**Tenure**	**Job Level**	**Performance Rating**	**Dependents?**	**Personality Type**
White	Female	35	8	MidMgmt	Average	Yes	Visionary

Next, we construct a matrix of program impacts based on employee attributes. Table 5 shows a sample matrix, with impacts coded as follows:

-3 = highly negative, **-1** = negative, **0** or blank = neutral (no impact), **1** = positive, **3** = highly positive

Table 5: Sample of Program Impacts by Attributes

		Education Program		Flexible Workplace			Etc…
Program/ Attribute	**Attribute Values**	**No Tuition**	**50% Tuition**	**No Flexibility**	**Flex Start**	**Telecom muting**	**Etc…**
Gender	M			-1	1	3	…
	F	-1	1	-3	3	3	
Age	GenY	-3	3	-1	1	3	…
	GenX	-1	1			1	
	Boom					1	
Tenure	Short	-3	3				…
	Mid	-1	1				
	Long						
Job Level	Empl	-1	3	-3	1	3	…
	MidMgt	-1	1	-1	1	3	
	Exec					3	
Perf	Avg		1				…
	Below						
	Above	-1	3				
Depdts?	Y			-3	1	3	…
	N				1	1	

Once we have obtained all of the impacts, we can compute the change in the retention probability of each employee. The resulting probability of retention for a particular employee, P(r), is computed as:

$$P(r) = \Delta P(r) + Base,$$

where $\Delta P(r)$ is the change in retention probability from the implementation of a set of programs, and Base is the base (or current) retention probability for the employee. The Base is usually obtained from historical records, while $\Delta P(r)$ is calculated from the aggregate impact of new programs, as illustrated in Table 5, and the impact of industry-wide retention drivers.

Industry-wide Impacts

As mentioned in Section 3.3, HR consulting firms are attempting to identify key factors that drive retention and attraction of employees. According to this research, there exist a set of drivers that are common to most employees, regardless of the industry. We have borrowed from various sources of this research to generate a set of drivers that seem to be highly rated by employees across all industries, ages, etc. as top reasons to join and stay in an organization. The industry-wide impact weights, denoted as α(driver), as shown below, represent the relative importance of each driver, based on survey data collected from various sources.

α(Compensation) = 0.79, α(Benefits) = 0.31, α(Career Devel.) = 0.27,
α(Work/Life Bal.) = 0.26, α(Manager Quality) = 0.50, α(Company Reputation) = 0.18,
α(Company Culture) = 0.13

Employee Impact Scores

The employee impact score for each driver will be the score, given the employee's attributes, that produces the absolute maximum impact. Thus, for a particular employee, the calculation of the final score for each program would be:

```
if (abs(Min)>=Max)
    Final Score = Min;
else
    Final Score = Max;
```

meaning that a negative score dominates a positive score of equal magnitude.

Once we have obtained the scores for each individual program, we relate them to the drivers, according to the driver-program matrix shown in Table 3; we see, for example, that the **"Work/Life Balance"** driver is linked to *Education Program* and *Flexible Workplace* programs. Therefore, the employee's final score for the **"Work/Life Balance"** driver will be derived from the impact of the linked program scores for those program options that are implemented.

For this example, let us assume that the implemented program options are *No Tuition Reimbursement* within ***Education Programs***, and *Flexible Start Time* within the ***Flexible Workplace*** program. A particular employee has a score of -1 for *Education Programs* and 3 for *Flexible Workplace*, resulting in an overall score for the **"Work/Life Balance"** driver of, $S(d_{worklife}) = 3$. Again, the maximum absolute score is selected, where ties favor negative scores. The final change in retention probability is obtained from a weighted function of all of the drivers.

5. Optimization of HR practices

Modeling all possible combinations of practices, recruitment budget allocations, and environmental parameters is virtually impossible, even for a small number of options[3]. Therefore, a procedure is needed that allows the user to focus on the set of scenarios that produce the best possible results. That's the essence of the technology embedded in the optimization component of OptForce -- the OptQuest Engine (see www.OptTek.com). The engine uses the most advanced global search

[3] If there were only 20 PPIs and two alternatives for each PPI, there would be about 1 million different combinations to choose from (ignoring any budget constraints).

algorithms to find the best solutions to simulation problems efficiently. This enables the user to focus on evaluating a limited number of potential solutions that optimization technology has concluded will most likely yield the best results.

Figure 6 shows the results of an optimization run of a strategic workforce planning session for an engineering services firm. The performance curve represents the readiness level, and each dot on the performance curve represents an improving solution in terms of readiness. The goals for this optimization were expressed as follows:

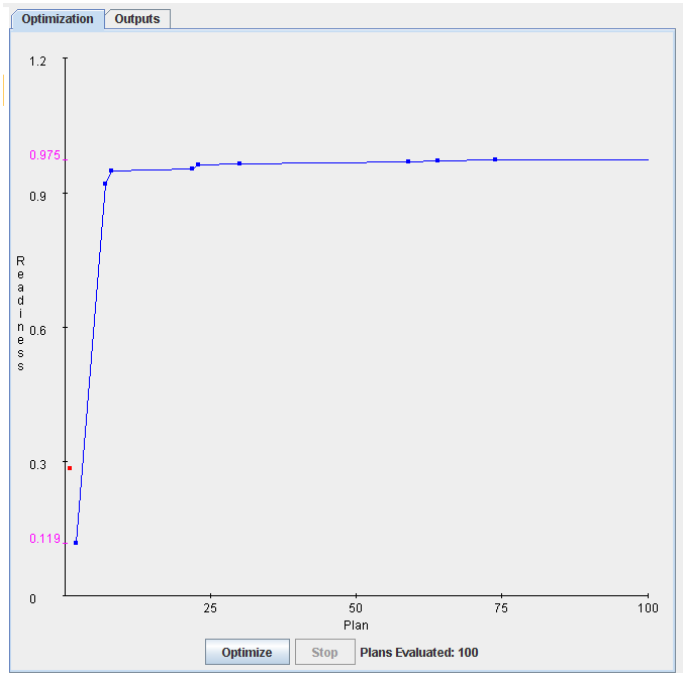

Figure 6: Optimization run showing 100 iterations

The company wants to maximize *readiness* on a 3-year planning horizon, while making sure that, at the end of the three years, non-white and female employees would represent at least 30% of the total workforce. In addition, the company imposed a $4M annual recruitment budget, a $10M annual retention budget, a $100M annual compensation budget, and a total annual HR budget (recruitment + retention + compensation) of $105M.

The best solution found is shown in Tables 7 and 8 below. From the tables, we can determine that, if we implement the program options marked "YES" in Table 7, and we allocate our $4M annual recruitment budget as depicted in Table 8, then we expect to achieve a readiness level of 96.3% at the end of three years. The total investment in personnel costs and expenses is $94.01M, of which $3.27M is spent in recruitment of new hires and $90.73M in compensation, benefits and other retention programs.

Table 7: Selected HR programs in the best solution

Program	Program Option	Selected?
Education	No tuition reimbursement	
	50% tuition reimbursement	YES
Flex-Time	No flexibility	YES
	Flexible start time	
	Telecommuting	
Healthcare Plan	HMO	YES
	A la carte	
Retirement Plan	401 K	
	401 K with matching	YES
Incentive Pay	No incentive pay	
	Profit sharing	
	Annual Bonus	YES
Compensation	At-market rates	YES
	Below-market rates	
	Hybrid rates	
Recognition/Awards	None	
	Monthly awards	YES
Ombudsman Program	None	YES
	Full-time ombudsman	
Training Program	New employee orientation	YES
	Annual training program	
Mentoring Program	None	
	Assigned mentors	YES
Diversity/Inclusion	Diversity policy	
	Quarterly diversity training	YES

Table 8: Recruitment budget allocation according to the best solution

Recruitment Channel	Budget Allocation
General Universities	**10%**
Social eNetworks	**5%**
Ethnic-serving Colleges	**75%**
University Job Fairs	**0**
Online Job Sites	**0**
Company Website	**0**
Recruitment Agencies	**0**
Ethnic-serving Agencies	**0**
Network Contacts/Referrals	**5%**
Publication Ads	**5%**

If we now simulate this particular solution to obtain more details, we see that women are expected to grow from 24.7% of the workforce to 39.8%, minorities from 25.5% to 43.5%, and that the age composition of the workforce varies from 35.6% to 40.2% in Generation Y, 23.8% to 42.6% in Generation X, and Baby Boomers go from 40.6% to 25.2%. Average annual turnover is 6.7%, total new hires are 39.4%, and total separations are 19.4%.

We could drill down further within each job level to view trends in workforce composition, performance ratings, etc. which would aid in proactive decision-making.

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