



The Balancing Act of Mobile Workforce Management

Fulfilling Multi-Service Objectives
with Priority-Based Optimization

Introduction

This white paper discusses the challenges of mobile workforce management, and in particular, handling multi-service objectives.

In addition, it highlights what ViryaNet G4 brings to the market as the industry's only auto-calibrating optimization technology with an embedded service priorities engine that enables the continuous optimization of scheduling resources within dynamic field service environments.

The Challenge

Your most efficient technicians are still limited by the schedule you provide them. You need to produce a plan that ensures you get the right person to the right place, at the right time, with the right resources and minimize your overall operating costs.

When dealing with complex and dynamic scheduling and dispatch decisions, even just agreeing on what "optimal" means or which plan best reflects a service organization's business needs is difficult. Ensuring those needs are automatically met by a computer algorithm, day-after-day in a constantly changing environment is a true challenge.



Multi-Objective Optimization¹

Workforce scheduling belongs to a category of multi-objective optimization problems.

Once you accept the premise that any schedule optimization problem includes multiple objectives, it follows that, in many cases, certain objectives will contradict others. For instance, travel time reduction, load balancing, and preferential scheduling of higher priority jobs can often be at odds with each other.

In trying to achieve operational excellence, service organizations face the complex challenge of defining, configuring, and measuring service objectives. You may be tackling this challenge, while analyzing many opinions on the effectiveness of a particular plan. Traditional workforce optimization approaches do not bridge the gap between the business needs and the “switches” and “toggles” necessary to configure today’s optimization algorithms. This lack of a direct correlation breeds doubt and exposes the results to subjective analysis.

To reach workforce scheduling operational excellence, service organizations need to clearly identify their different service objectives and how they want to balance them. Then, they must be able to capture those objectives in a language that will be understood by both the operations manager and a computer algorithm. The resulting schedule, because it is based upon clearly-defined business objectives, becomes less prone to subjective analysis or second-guessing.

Achieving this outcome is to set the bar high, but it is a goal worth pursuing. Because when all is said and done, you cannot expect your valuable resources to be more effective than the plan you have provided to them.

Balancing Service Objectives

Setting Your Goals

The first step to solving an optimization problem is clearly identifying your goals. When it comes to mobile workforce scheduling optimization, this means:

1. Identifying your service organization’s objectives. For example: minimizing travel time or maximizing the load balance between field technicians. It could be something more complex, such as minimizing the risk of missing an appointment with a customer.
2. Defining the desired balance between often-contradicting service objectives.

¹Multi-objective optimization (or programming), also known as multi-criteria or multi-attribute optimization, is the process of simultaneously optimizing two or more conflicting objectives subject to certain constraints. Multi objective optimization problems can be found in various fields: product and process design, finance, aircraft design, the oil and gas industry, automobile design, or whenever optimal decisions need to be taken which involve trade-offs between two or more conflicting objectives. For example, maximizing profit and minimizing the cost of a product; maximizing performance and minimizing fuel consumption of a vehicle; and minimizing weight while maximizing the strength of a particular component. All of these are multi-objective optimization problems. If a multi-objective problem is well-formed, there should not be a single solution that simultaneously minimizes each objective to its fullest. In each case we are looking for a solution for which each objective has been optimized to the extent that if we try to optimize it any further, then the other objective(s) will suffer as a result. Finding such a solution, and quantifying how much better this solution is compared to other such solutions, (there will generally be many) is the goal when setting up and solving a multi-objective optimization problem.

Service Objectives: Customer Satisfaction

When service organizations implement mobile workforce management solutions by optimizing their mobile resources assignments plan, they immediately face an inherent complexity. How do you balance customer satisfaction with resource productivity? But before diving into this, we will first focus on what customer satisfaction really means and how it affects the assignments plan.

Instinctively, customer satisfaction is strongly related to the contractual agreement between the service provider and its customers, or more specifically, the service level agreement (SLA) part of this contract. Common SLA metrics that can be found in the service market are:

- uptime
- mean time between failures
- turnaround time

The big question is how to translate these SLA metrics into planning and execution policies and best practices.

Many service organizations do focus on measuring their SLA compliance, but measurement alone will not provide better service. Service organizations that want to become best-in-class need to think beyond the standard SLA metrics. When it comes to day-to-day execution, it is easy to understand the concepts of predictability and communication as key factors that make for a superior end-user experience. But what about the planning phase? What elements can be brought to an assignments plan to make it more customer-friendly?

When we think about a customer-friendly plan, we think about 3 key objectives:

- quality
- impact
- risk

“Quality” includes elements such as previous involvement or technician seniority.

“Impact” considers the overall effect to end-users. This impact could be a combined measure of:

- How many end-users are affected?
- How long are they waiting?
- And what is the direct effect on them?

“Risk” is another interesting factor. When creating a plan where a lot of focus is given to meeting service commitments (i.e., scheduled appointments), you have to examine the risk of keeping this commitment in the event that something goes wrong. Would it be better to finish all your commitments as early as possible?

Given all these considerations, you certainly have to take quality, impact and risk into account. But how simple is it to balance these objectives among other contradicting ones, such as driving time? Do you ask your technician to drive 15 more miles because of his previous involvement with the same customer? Or when do you send two technicians to the same neighborhood to minimize the risk of missing appointments in this region?



Service Objectives: Workforce Productivity

When we think of a plan that drives productivity, we think about more than just utilization, we think about suitability, fairness, and that more elusive objective: disruption level.

Productivity is obvious, any service organization would like to plan for its resources to be working, rather than driving or waiting.

Suitability, very much like quality discussed in the context of customer satisfaction, takes into account the familiarity of a specific technician with the work environment; anything from experience to knowing the customer, to the neighborhood dogs to avoid.

Fairness would consider balancing the work and the timespan to measure the workload balance (Would you like to balance the planned work in the morning hours? Knowing that later you will be forced to respond to same-day interruptions throughout the day. Or would you settle for a weekly or even monthly balance?). After all, assuring your workers are happy will drive their productivity.

The disruption level objective is somehow more complex. But with sophisticated optimization systems, when you combine short- and long-duration work, you need to decide when it makes sense to pull someone off a long-duration work assignment and send him to do something else. By utilizing every free minute, you can boost productivity, but you need to ensure you are not crossing a fine line with your employees – making them jump from task to task and making them less efficient.

But how to solve this complex puzzle? And what is needed in order to optimally balance between these different objectives?

Service Objectives: Putting It All Together

We have discussed a variety of workforce planning business objectives. Starting with planning objectives that take into account customer satisfaction metrics, such as: quality (of work), impact (of a failure) and risk (of missing a commitment), and moving to planning objectives that consider productivity metrics, such as: utilization (of resources), suitability (to do work), fairness (between resources) and disruption levels (to a day's flow).

The pinnacle for any service organization is finding the exact, fine-tuned balance between these contradicting objectives and achieving full alignment with the organization's strategic goals.

In this journey, the service organization is likely to face these challenges:

- How to define planning objectives that would best represent the organization's goals?
- How to ensure that employees' hard work is not actually running counter to the organization's goals because they have a different understanding of what you are trying to accomplish?
- How to ensure that automatic planning decisions, performed by a computer algorithm, are aligned with the organization's goals (and more so, in a complex and dynamic environment)?

The problems reflected in these questions point to the issue of organizational alignment. While different [performance management](#) frameworks has been touted as an effective tool for creating organizational alignment, the actual success of the system as an alignment tool can vary depending on the strategic focus of the framework (simple performance measurement dashboards tend not to be very helpful), the success of its implementation, and whether or not the organization successfully cascades the framework down to business or support unit level and/or individual levels.



The Human Factor

Think about a service organization that used to plan mobile workforce schedules manually, and is now, for the first time, introduced to a much more sophisticated automatic scheduling optimization technology. In most cases, the service organization should be prepared to face a significant change management challenge in bridging the gap between how human dispatchers approach a scheduling problem vs. how a computer algorithm approaches the problem.

There are 3 elements to how a human thinks about a scheduling problem which is different from a computer algorithm.

The first is problem scoping. The typical human approach to a large-scale scheduling problem is to simplify it by self-imposing constraints. For example, in every service organization there are zone constraints (technicians are placed in certain parts of town) or rules that create a linkage between assets and the technician that is responsible for fixing those assets. Do these constraints truly reflect business needs? In many cases, these constraints are just the need to simplify a scheduling problem that human dispatchers are trying to solve. Instead of optimizing a large-scale problem, the human or manual approach “sub-optimizes” by solving several smaller scale problems. However, computers are bound by true business constraints.

The second is consecutive decision making. The typical human approach focuses on a certain job (“highest priority” or “next closest in the region”) and finds the most suitable resource to do that job, and then, moves on to the next job. There is one big disadvantage to this approach: the order in which you make your individual decisions has a significant impact on the quality of the overall plan. In the human approach, there is no magic formula to tell you the best order. A computer algorithm starts with exactly the same process, but a best-in-class system follows up with an iterative improvement process that looks at a plan, finds assignments that can be improved, then un-assigns and re-assigns them.

The third is assessing the overall quality of a plan. Humans normally focus on “local quality” indicators (e.g., crossing routes or resources that did not receive any work), but find it difficult to link these indicators to overall service objectives. For example, if resource suitability is more important than load balancing the work, maybe it makes sense that a resource has no work. Not surprisingly, it is common to find that different dispatchers make different subjective assessments as to the quality of a given plan.

These subjective differences, and the reasons a human dispatcher cannot beat a computer algorithm in a planning contest, emphasize the need to take change management very seriously in conjunction with the introduction of optimization technologies.

Comparing Optimization Solutions – Quality and Benchmarks

A good resource optimization engine is a key ingredient for any service organization aiming to become best-in-class.

When service organizations are in the process of selecting an optimization engine, they often put a lot of attention to compare functionality, but surprisingly, often overlook, or do not have the tools to assess quality. Especially given the fact that optimization towards contradicting business objectives is a very complex problem that can be approached by very different solution strategies.

So what does it take to compare the quality of 2 optimization solutions?

- The optimization problem defined (the in-use constraints and desired objectives)
- The test data: a broad set of data representing variations in the operational conditions

The combination of the “optimization problem defined” and the “test data” is often called a “benchmark problem”.

This benchmark problem leaves the sophisticated service organization with two options: either build your own benchmark problem or use an existing one.

Working in the mobile workforce management industry for many years, we hear too often that optimizer quality cannot be compared or that known benchmark problems do not exist.

At ViryaNet, we test every optimizer release against the well-known benchmark to optimization professionals: the Solomon benchmark.

The Solomon benchmark is a set of 56 different problems categorized to 6 different sets. The benchmark problems differ:

- number of customers serviced by a vehicle
- percent of time-constrained customers (appointments)
- tightness and positioning of the time windows, and
- geographical distribution

In particular, what we like about this set of problems is the opportunity to test your optimizer against a diverse set of cases. For example, when one day, scheduling needs are different from another, which is what happens in real life. Getting good results, against all those variations, without changing your optimizer configuration, is a challenge for a strong optimizer.

When you are evaluating optimization solutions, do not forget about quality, and challenge your optimizer vendor with a benchmark problem.

Comparing Optimization Solutions – Tuning & Configuration

Tuning any optimizer – so it can create an optimal assignment plan that best reflects your service objectives – is difficult.

There are 3 challenges that make optimizer tuning difficult:

- First, it is hard to agree on what should be the balance between different service objectives.
- Second, it is hard to translate the desired balance between service objectives to a configuration set of a computer algorithm.
- Third, when translating objectives to static configuration, there is an ongoing risk of better or worse results, depending on the differences between data sets (e.g., utilization levels, work geographic distribution, etc.).



In the industry today, the most widely used approach is a weighted sum formula (this method is based on selecting the best assignment plan to maximize a function that sums the objectives with relative weight of importance) to solve a multi-service objectives problem. But the weighted sum approach does not handle the 3 challenges mentioned above.

Agreeing on a set of weights that present the desired outcome of an optimization run is not an intuitive process. Many times, a trial-and-error process is required to get closer to the desired set of weights. This trial-and-error process is cumbersome, as well as subjective and sensitive to the data set used. Moreover, when applying a static configuration at the end of this process, you should expect optimizer “bad hair” days.

These challenges drove ViryaNet to develop a different approach. We introduced a method of prioritizing the different objectives, which is much more intuitive and creates a separation between deciding on your goals and testing the outcome of the optimizer. This approach brings clarity and objectivity and simplifies the configuration process.

ViryaNet also introduced a method to auto-tune the optimizer, so rather than settling for static configurations, you can let the optimizer find the configuration that best matches the data set in hand and the prioritized objectives to provide optimal results day after day, run after run.

When evaluating an optimization solution never underestimate the complexity of an optimizer configuration/tuning process and its ability to impact your overall success.

Summary and Conclusions

- Excelling in mobile workforce planning drives continuous service operations success.
- Mobile workforce scheduling is a multi-objective optimization problem. In many cases, the different service objectives are in conflict.
- Definition of the optimization goals includes both defining the service objectives and the balance between them.
- A strong optimizer will get good results, against many variations, without changing your optimizer configuration.



APPENDIX A

ViryaNet G4 – Multi-Service Objectives Support

ViryaNet G4 ensures optimal daily schedules to best reflect service business priorities.

ViryaNet G4 is the industry's only auto-calibrating optimization technology and embedded service priorities engine that enables the continuous optimization of scheduling resources within dynamic field service environments.

To achieve objective-based modeling in ViryaNet G4, we:

- Provide customers with a clear, out-of-the-box set of supported objectives, built from the most common mobile workforce management business objectives.
- Use these out-of-the-box objectives within ViryaNet G4 to intuitively define the balance between objectives by prioritizing the objectives and defining threshold levels for compromising a higher-priority objective in favor of a lower-priority one.
- Auto-tune the internal parameters of the optimizer, with every run, to best accommodate the prioritized service objectives and the data for that run. So you do not have to worry about having an optimizer "bad hair" day.
- Offer an easy way to objectively measure the quality of a plan, and
- Provide greater visibility into the planner by measuring and presenting the objective's results for each plan.



ViryaNet G4 Objectives

All objectives are categorized into one of three groups: 1) which jobs to assign; 2) to whom; and 3) when should the work and resources be assigned.

These objectives help to:

- maximize the assignment of urgent work
- maximize the assignment of filler work
- minimize travel time
- maximize resource suitability
- maximize workload balancing
- minimize risk of missing time limit
- assign work as long before the required end date as possible
- assign higher priority earlier in the route
- maximize segmentation quality

ViryaNet G4 Benefits

ViryaNet G4 utilizes priority-based, objective modeling for:

- Continuous execution towards the highest possible quality schedule.
- Increased visibility into the plan/schedule in relation to the specified objectives.



What objectives are you trying to balance?

[Find out how ViryaNet can help.](#)

About ViryaNet

ViryaNet delivers mobile workforce management solutions that intelligently guide, automate, and optimize both simple and complex field service work, resulting in measurable business benefits. ViryaNet's products, pre-packaged solutions and people are recognized within the industry as innovative which in turn enables its' customers to be viewed as leaders within their respective industries. ViryaNet's G4 products specialize in the functions of scheduling and dispatching resources and enabling mobile field communication and are delivered in industry specific configurations. Embedding industry best practices and utilizing innovative technologies like ViryaNet's BPM Blueprint for Mobile Workforce Management™, Microsoft InfoPath® and device agnostic mobile solutions enable ViryaNet's products to be rapidly deployed and extended to support virtually any business process across a wide range of industries. ViryaNet is proud to call many of the world's leading utilities, the United States' largest pure rural telecommunications firm, the supermarkets most respected retailer, and North America's largest auto insurer as customers. ViryaNet has strong partnerships with leading platform and system integration companies that enable it to have a global presence. Headquartered in Westborough, MA, ViryaNet has additional offices in the United States and Israel. For more information [visit our website](#) or [follow us on twitter](#).

