The Complete Guide To Workforce Optimization

How to use advanced planning and scheduling techniques to keep employees and customers happy while operating efficiently and profitably.

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Table of Content

Introduction

Welcome to our Complete Guide to Workforce Optimization. We developed this guide for business leaders who are considering or have already begun leveraging advanced decision support software to make better workforce planning and scheduling decisions.

This in-depth guide is particularly relevant for organizations that manage large teams of employees in the field, such as maintenance and repair technicians, cleaning and sanitation workers, field sales representatives, caterers, security guards, construction workers and inspectors.

What is Workforce Optimization?

Workforce Optimization (WFO) is a very broad term but at its highest level, it's a set of approaches to achieving business success through smart workforce management. Interestingly, the Wikipedia page on workforce optimization focuses almost entirely on contact centers, but we think workforce optimization is much broader.

This guide is focused on those aspects of WFO that relate to planning and scheduling. That's because, for many industries, these activities tend to have the biggest and most measurable impact on business key performance indicators (KPIs). Planning and scheduling are also the functions in which almost all HR, workforce management and field service management systems fall short. That's not surprising because these functions are rarely standardized across companies. The factors that go into scheduling warehouse workers at Amazon fulfillment centers are very different from those for scheduling agriculture inspectors, which are also different from those of appliance technicians.

What Kinds of Planning and Scheduling Problems Can Be Optimized?

Workforce optimization problems are usually classified based on time horizon, which is the time period that is considered when creating the plan. This chart gives a good overview of the types of WFO problems that are good candidates for optimization, broken down by planning period:

	Planning Period	Examples of typical planning issues
STRATEGIC DESIGN	• Above one year	• What is the ideal workforce size and what are the shifts that should be implemented to maximize productivity • What skillset profile should own employees have and what part of workload should be subcontracted
TACTICAL PLANNING	• Weeks to a few months	• How to optimally distribute planned activities to better cope with demand variability and seasonality • How to better plan for employees' vacations and leverage temporary workers to meet forecasted demand
OPERATIONAL SCHEDULING	• Hours to a few days	• How to optimally schedule existing workorders to maximize productivity and SLA adherence • How to best adjust schedules due to unexpected workorders or due to unexpected employees' unavailability
REAL-TIME ADJUSTMENTS		• How to optimally adjust schedules to react to real-time events and emergencies

The Ultimate Goal: Fully Integrated Workforce Optimization

Like many things in life, so it is with workforce optimization in that it's best to start small while dreaming big. No matter which WFO use case you begin with, remember that business success is greatest when optimizing along all 3 time horizons together. This can be well achieved with WFO systems by cascading the results of longer planning horizon systems as inputs into the shorter horizon systems. This kicks off a feedback loop that drives continuous improvement of plans and schedules.
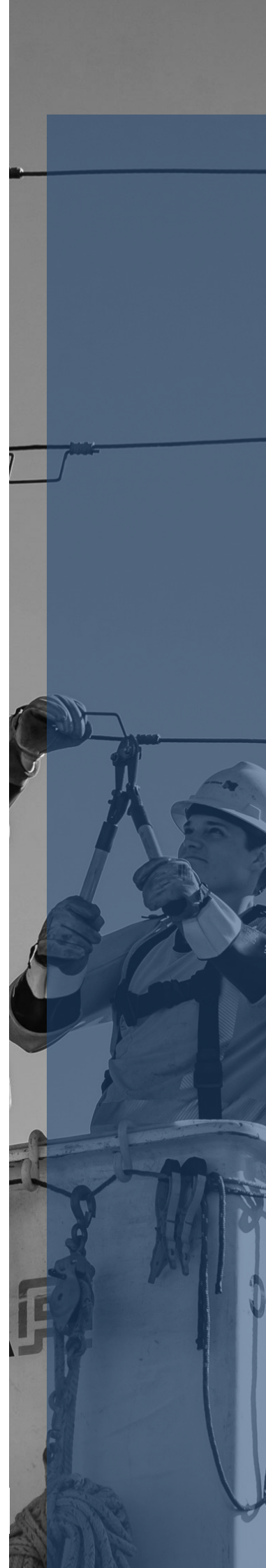
Part 1: Cataloging Employee Skills & Work Activities

The foundation of any good decision, plan or schedule is data. That's why one of the most critical aspects of any workforce optimization project is the collection and preparation of data. In this first section of our guide, we go over some of the key data elements that must be prepared.

Why is it Necessary to Catalog Employee Skills and Work Activities?

The primary purpose of workforce optimization is to match workforce supply (capacity) with work demand while meeting business objectives, such as minimizing over and under staffing. This is often referred to as capacity planning. Here are a few examples of application screenshots that illustrate some ways that capacity and workload can be shown and compared:
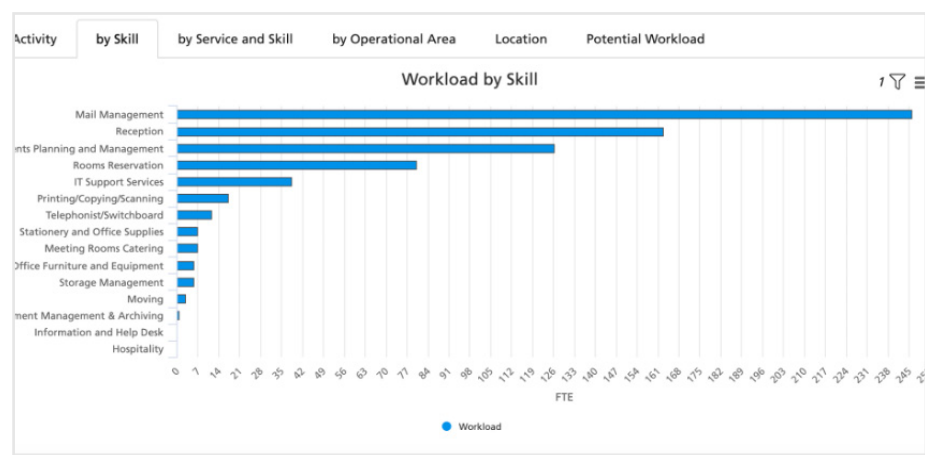

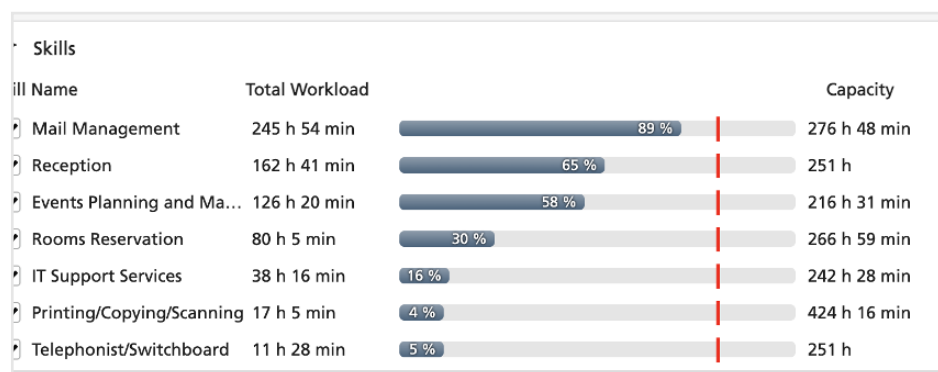**Figure 1: Chart showing total workforce capacity by skill`**

Figure 2: Chart shows workload as a percentage of capacity

The Complete Guide To Workforce Optimization

In the following example, you can see by day of the week that total workforce capacity (the blue line) usually exceeds demand, except on Saturdays, when capacity is low.
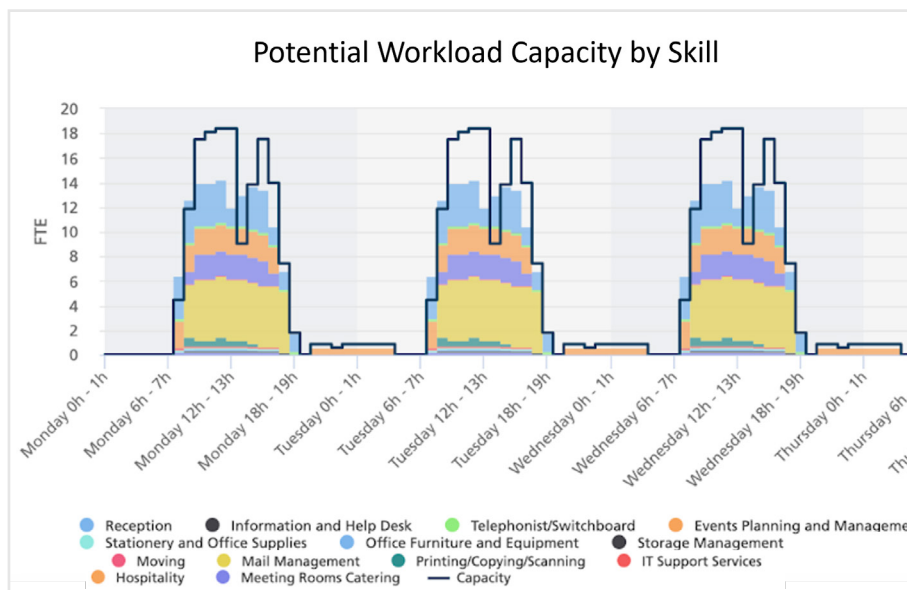
Figure 3: Workforce capacity by day, broken out by type, overlaid with demand

What is a Skills Catalog or Taxonomy?

A WFO system needs access to a complete and detailed catalog or "data dictionary" of all relevant information about workforce capacity (how many workers with which skills are available), work demand (how much of what kind of work is needed) and other related data - such as asset type or service type, which might be relevant for a services company.

Most organizations have a standardized set of job roles with skills that are associated with each of them. In this way, job profiles are formalized. For example, the mapping between job roles and skills may look like this:

JOB ROLE	SKILL
Cleaning Helper	Cleaning Simple Tasks
	Generic Cleaning
	Washroom Cleaning
	Generic Waste Collection
	Consumables Management
	Indoor Planting
Cleaner	Cleaning Simple Tasks
	Generic Cleaning
	Washroom Cleaning
	Consumables Management
	Generic Waste Collection
	Indoor Planting
	Dust Control
	Kitchen Cleaning

Figure 4: Example of Part of a Skill Taxonomy capacity

For organizations whose employees carry out one or more services for clients, the skills may be mapped to "services" which could be grouped in different ways. For instance, here is a 3-tier hierarchy in which services are bundled into groups, which roll up to service lines:
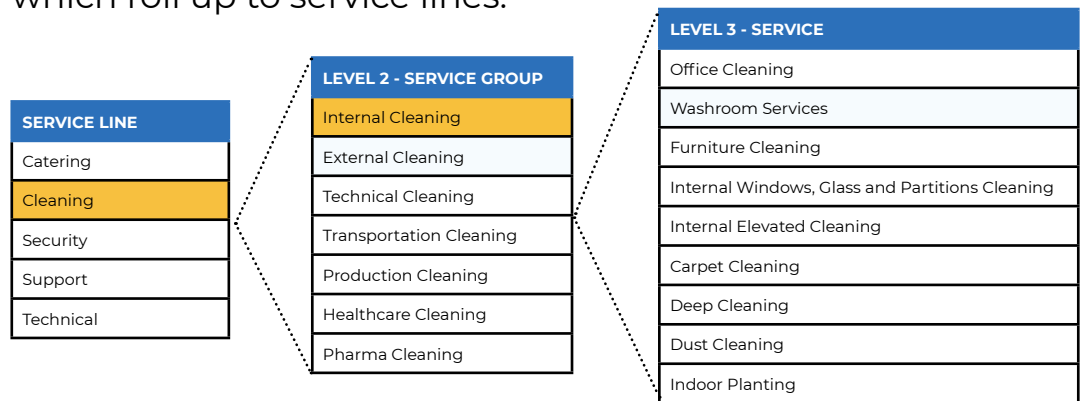
SERVICE LINE		LEVEL 2 - SERVICE GROUP		LEVEL 3 - SERVICE
Catering		Internal Cleaning		Office Cleaning
Cleaning		External Cleaning		Washroom Services
Security		Technical Cleaning		Furniture Cleaning
Support		Transportation Cleaning		Internal Windows, Glass and Partitions Cleaning
Technical		Production Cleaning		Internal Elevated Cleaning
		Healthcare Cleaning		Carpet Cleaning
		Pharma Cleaning		Deep Cleaning
				Dust Cleaning
				Indoor Planting

Figure 5: Example of a Service Level Taxonomy

It's now becoming clear that our skills and job data catalog includes relationships and hierarchies between the data elements. This kind of catalog is therefore more commonly referred to as a taxonomy or sometimes an ontology. Here is another way to represent the relationships between fields in the above taxonomy:

Conceptual Structure
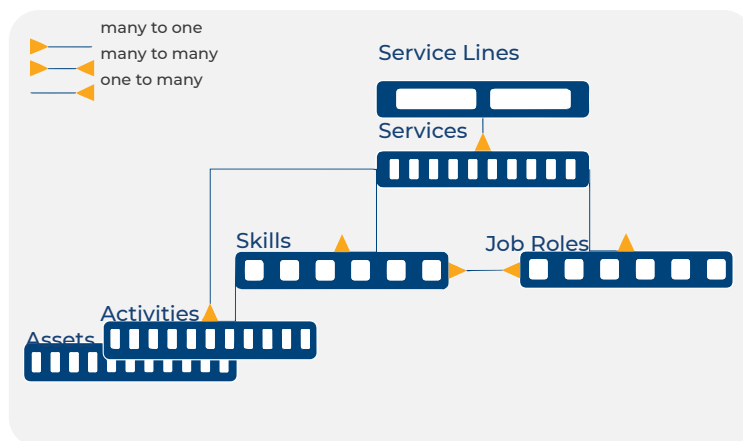
Figure 6: Service and Skill Taxonomy Flowchart

What about Assets?

For some industries, the work conducted by employees is tied to assets. Appliance repair technicians or telecommunications system engineers are two examples. Organizations with these roles typically have an enterprise asset management system or database where the information about these assets is stored. The asset-level data is often also referred to as an asset taxonomy.

The WFO system will need to integrate this data in order to properly match engineers or technicians with the equipment or asset groups that they can work on.

What about Personnel?

Similar to the asset management system mentioned above, many organizations also have human resources (HR) or workforce management systems in which the details of all of the employees in the organization are stored and managed. The WFO system will similarly need to integrate this data in order to match employees with their respective skills and job roles. The WFO system also needs to understand each employee's working preferences and constraints, vacation, pay rates, and other such information that impacts how they are planned and scheduled.

Data Integration - The Necessary Plumbing

One of the most critical and sometimes quite time-consuming aspects of a WFO implementation project is the integration of all of the data. That's because, for most WFO use cases, the needed data does not live in one place, plus some of the data might not even exist, such as job roles and skills data.

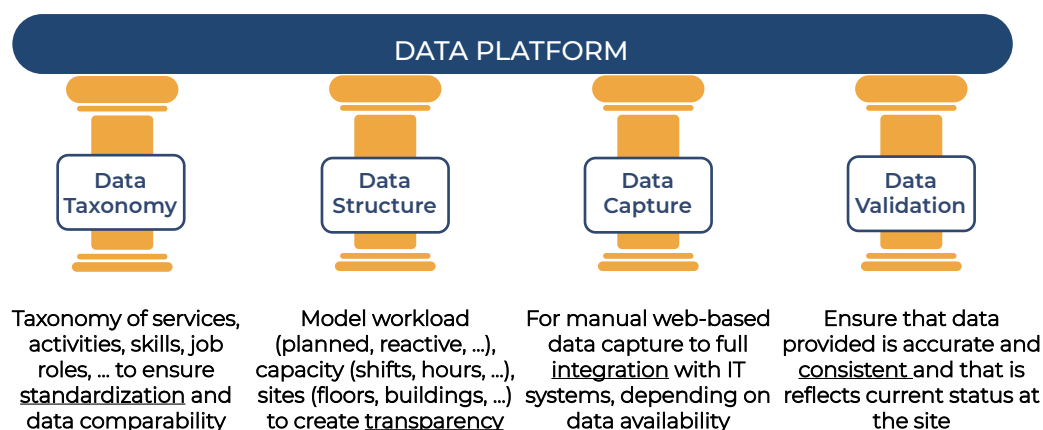| DATA PLATFORM			
Data Taxonomy	**Data Structure**	**Data Capture**	**Data Validation**
Taxonomy of services, activities, skills, job roles, … to ensure standardization and data comparability	Model workload (planned, reactive, …), capacity (shifts, hours, …), sites (floors, buildings, …) to create transparency	For manual web-based data capture to full integration with IT systems, depending on data availability	Ensure that data provided is accurate and consistent and that is reflects current status at the site

Figure 6: Service and Skill Taxonomy Flowchart

Though data integration is a large topic unto itself, we want to point out that there are several different approaches one can take, many of which only take a few days or weeks to set up.

Start Creating your Taxonomy

Creating a skills and work activities catalog and taxonomy is fundamental to running any **data-driven initiative to improve workforce efficiency** and make the right strategic, tactical, and operational decisions to ultimately meet your business goals.

To help you create your own catalog, we created a quick-start Skills Catalog template in Microsoft Excel that you can use to take the first step on your path to workforce optimization.

Part 2: Benchmarking Performance Metrics

In services industries, accurate and granular benchmarking metrics enable bidders to set the right price so that the project is priced competitively but can still be profitable.

What is Meant by Performance Benchmarking?

Performance benchmarking is about quantifying the normal expected amount of manpower to satisfy a given type and unit of demand. For the purpose of planning and scheduling, we are not factoring in a work quality metric but assume that all workers have similar productivity for a given task. In other words, we are setting the expectation for how many desks, hospital beds or square feet of space can be cleaned per hour.

Who Needs to do Performance Benchmarking?

Performance benchmarking is usually needed in industries with workforces that perform regular and repeatable activities, such as cleaning and sanitation, security, catering and facility management.

Benchmarking is not usually required for organizations whose employees are performing complex or unpredictable reactive support and repair services, such as automotive or appliance repair or emergency medical technicians. In the case of technicians performing routine planned or preventive maintenance, service times for these activities are usually known. Contact center performance metrics are also fairly well-known by service providers.

Any organization that doesn't feel they have task-level performance data may need to perform benchmarking before implementing an optimization system. This performance benchmark data will later be joined to the taxonomy discussed in the last part.

What is the Right Level of Granularity & Measurement Unit?

Benchmarking can be done at different levels of granularity, from the single activity level (ex. cleaning windows) to the service type level (ex. interior cleaning). The level of granularity may require some thought. If the granularity level is too fine, then the data collection and integration effort will be higher. For instance, you may not need to detail out the time it takes for a senior housekeeper vs a junior housekeeper to clean a room.

Too coarse a granularity, on the other hand, will result in plans and schedules that are less optimal, meaning frequently overstaffed or understaffed. This could happen, for instance, if you don't account for the extra time it takes to clean a multi-room suite.

The units of measurement can also vary by work type. Some examples are the time it takes hospital staff to perform various medical procedures may reside in a lookup chart of minutes per procedure. Cleaning staff may be benchmarked based on the number of square feet, hospital beds, rooms, or windows serviced in the case of window cleaning. It's a good idea to involve front-line managers to determine which are the best metrics to use.

How to Derive Performance Metrics

There are different approaches to measuring performance. The traditional way is to observe the worker. The problem with this approach is that a worker may feel pressured to work at higher-than-usual efficiency, so the numbers may not scale well.

A good practice is to perform benchmarking passively through analytical approaches. This could involve looking at historical staffing levels alongside, say, patients served, hotel occupancy rates, commercial office square footage, or the number of desks cleaned. From there, performance averages can be derived based on the number of hours worked per person, per unit (ex by room, desk, or square feet).

Communication is key

Benchmarking employees can be a sensitive topic, especially for unionized workers. That's why it's critical that leadership effectively communicate why and how the information will be used.

Some industries, like warehousing, often use benchmarking to drive greater productivity through competitive peer pressure. This is probably not ideal, for a services outsourcing company that needs to balance costs with service levels.

Whatever the reason for doing benchmarking, you should make it clear to your employees **why you're doing it** and **how it benefits them** and the company.

Use our [Benchmarking worksheet Excel template](#).

Part 3: Handling Uncertainty with Forecasting and Capacity Planning

We are now almost ready to start optimizing our workforce, meaning matching workforce capacity (employees by skill) to work orders or work demand. If you're new to workforce optimization, this may sound easy - and in some industries it is. But in others, it quickly gets extremely complex. Let's explore why.

What is Forecasting?

For workforce optimization, **Forecasting** is about **predicting future demand for work to be done.**

Some future demand is easy to forecast. For instance, a hotel chain may know how much catering demand will be needed next month based on banquet room reservations.
Other types of workforce demand are harder to predict. Imagine a call center that handles a large volume and variety of calls or a hospital that tends to patients afflicted with any number of illnesses and injuries. There could be many factors that influence workforce demand to varying degrees, such as:

- Weather data could correlate with certain illnesses
- Point-of-sale data could correlate with demand for call center support tied to certain products
- Satellite parking lot data could be an indication of crowding indoors, which might correlate with disease spread
- Local crime rates could correlate with gun or knife injuries
- COVID testing center data could correlate with hospital ICU demand.

Various AI and ML methods are commonly used for forecasting demand in situations like these. At a very high level, they work by analyzing large amounts of historical data and deriving a mathematical model (formula) based on the detected drivers of that demand. This model can then be applied to predict the future. This "demand forecast" can then feed any downstream systems that support decision making, such as workforce planning and scheduling systems.

What is Capacity Planning and Why is it Hard?

Workforce *capacity planning* is about ensuring that you have the **right size and mix of workforce to satisfy the forecasted demand.**

This may sound easy, but workforce capacity planning is quite challenging because human workforce capacity is not instantly available on-demand in discrete time buckets the way, say, cloud computing resources are available. Workers are hired, trained and retained on a long-term basis, whether as contractors or employees. They work according to shifts and are subject to many constraints on working times and durations. It may sound strange to put it this way, but if we want to leverage AI software to help optimize the way workforces are planned and scheduled, this is how capacity must be modeled programmatically.

Other factors that make capacity planning challenging include:
- Employee availability is constantly changing and often uncertain due to staff turnover, illnesses and other unforeseen absences.
- Workforce capacity is broken out based on skills and expertise. You may seemingly have enough total headcount, but the wrong skillset mix to fulfill demand.
- Sometimes different roles have overlapping skills and this needs to be accounted for correctly.
- Employees are constantly building new competencies that need to be considered. These new competencies are ideally based on the recommendations of optimization-based planning systems. This will be discussed later in this guide in the part about Strategic Planning.

Below is an example of a capacity planning screen for a contact center that is creating optimized daily schedules for agents. Each row represents an agent's schedule. The color of the box indicates the type of work assigned per time period (phone response, email response, administrative work, etc).

Notice that agents are usually assigned to the same task for long stretches, if not the entire shift, in order to reduce inefficiency from task switching.

One can also see that daily schedules are limited by total hours and mandatory breaks are scheduled in. On the second chart you can see overall how well the schedule is meeting demand. Workforce capacity, shown in gray, is usually higher than demand except in the early morning at around 1:30 when the call center is slightly understaffed.

Figure 7: Capacity Planning System for Call Center

How to Optimize Capacity Plans

Now that we have a high level understanding of what demand forecasting and capacity planning are, we can start to think about how to create optimized capacity plans. This is in fact the subject of the next 3 posts in this series. That is because capacity planning optimization can get very complex very quickly.

In order to reduce complexity, industry practitioners usually segment capacity planning problems into 3 problem types based on the time horizon that is being considered: strategic capacity planning (~ annual), tactical capacity planning (~monthly) and operational scheduling (~daily/hourly). Optimization can be applied to each of these 3 problem types individually, but when it is applied to all three the results are maximized.

Conclusion

Forecasts and capacity plans are critical inputs into planning and scheduling systems. When done correctly, forecasting and capacity planning enable leaders to make informed decisions about hiring, training, leave approval and scheduling in order to reduce costs and employee turnout while maximizing service levels.

Part 4: Operational Scheduling

Now we're finally able to begin reaping the benefits of all of this foundational work and **start optimizing!**

Why start with Scheduling instead of Planning Optimization?

We are beginning the optimization topic with **operational scheduling** rather than strategic or tactical planning optimization because it's where, for many of our customers, the day-to-day "pain" is most apparent and urgent.

While we have supported clients in addressing optimization opportunities along the three planning horizons (strategic, tactical, operational) in different orders, a best practice would be to tackle strategic planning first, followed by tactical planning and then operational scheduling.

The reason for recommending strategic and tactical planning optimization first is because they usually deliver the greatest ROI: the benefits of good strategic decisions, such as hiring the right workforce, can have the biggest impact on the business KPIs, whereas even the best operational scheduling system in the world can't entirely fix, say, a shortage of workers with the right skill sets or improper distribution of the skills across a region.

The tradeoff, however, is that the ROI for planning optimization takes the longest to realize because one must wait for the next planning period (typically a year or more out) to be well underway before the impact can be felt. In contrast, operational scheduling optimization's benefits begin accruing within days or weeks of implementation.
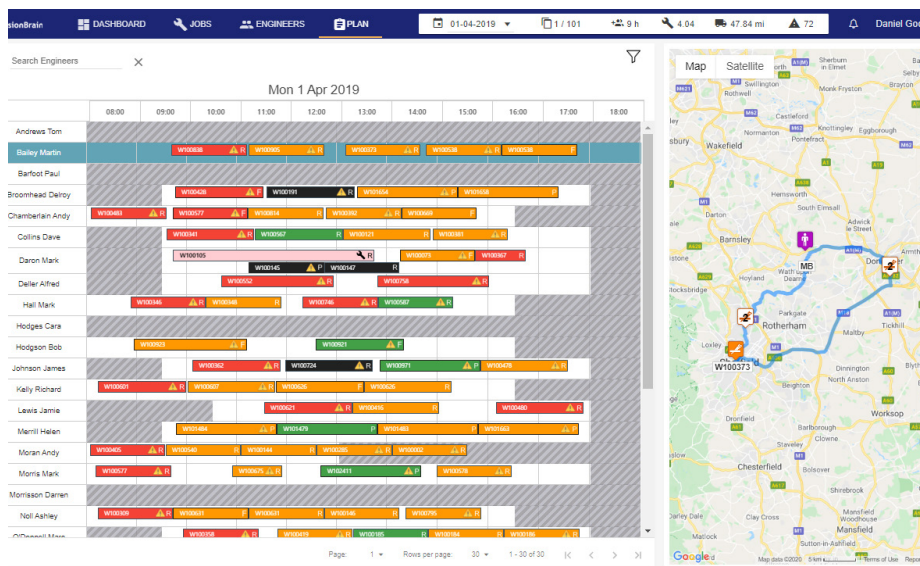
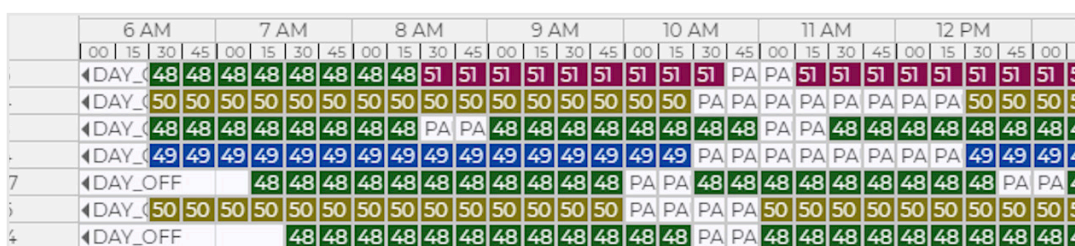Figure 8: Technician Scheduling Dashboard

Figure 9: Contact Center Agent Scheduling Chart

Operational Scheduling Challenges

Workforce scheduling isn't always hard, but for most organizations with hundreds or more employees, it can get surprisingly complex very quickly. Here are some contributors to scheduling complexity:

- A workforce made up of people with different skills, which must be matched to different kinds of work demand. This could apply in a call center or field services, for instance.
- Staff are geographically distributed, so proximity and route to work location must be considered.
- The work is a mix of regular recurring and reactive jobs, common with technicians or emergency responders.
- Last-minute situations, such as employee absences or rush jobs require adjustments that can have ripple effects on the schedule.
- Allowable visits or work windows may be tight or vary, such as with medical sales reps who visit doctors during their opening hours.
- Availability of scarce or shared equipment must also be considered in the schedule, such as construction or hospital equipment.
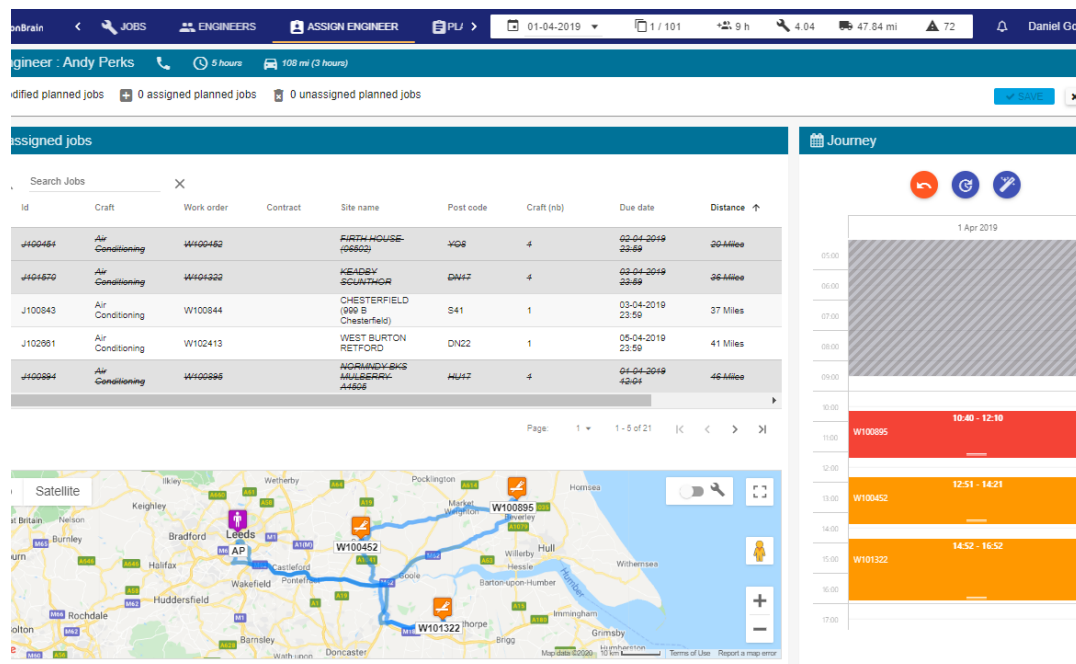- Customer or work priorities and service level agreements vary.

Figure 10: Unassigned Job Handling Screen for Schedule Repair

Workforce Scheduling, Rostering, Field Service Management and Shift Management Software

Most organizations find it impossible to manually create consistently good schedules when faced with the challenges above, especially when trying to balance across competing objectives, like minimizing costs, maximizing customer service levels and satisfying employee preferences.

This is why organizations often use software to help with scheduling. But what kind of software is appropriate?

There are many types of software systems that claim to facilitate, automate and even "optimize" employee scheduling. They include:
- Rostering systems
- Workforce Management (WFM) systems
- Shift Management software
- Employee/Workforce Scheduling software
- Field Service Management (FSM) systems
- Customer Relationship Management (CRM) systems.

An Internet search will produce endless "top 10" lists and reviews of the various systems. The differences are usually based on the "accessory" functions of the systems, which are outside of scheduling optimization. That is because most of these systems are touted as "one-stop shops" for all of your workforce management needs rather than being focused on operational scheduling optimization. That's not to say they aren't good systems - they include very important features like time and attendance management, GPS location tracking, mobile interfaces, shift bidding, integration with financial, asset management and/or CRM systems and other such management and execution functionality.

The limitation of nearly all of these systems is that the scheduling functionality is too simplistic. The scheduling functionality is either manual (calendaring) or, if automated, is extremely limited in the number of factors that can be considered when producing the schedule. This is due to the exponentially increasing number of schedule possibilities (and therefore, problem complexity) that results when you want to consider several factors.

Let's take, for instance, just one of the factors listed above, which is that of a geographically distributed workforce. Let's say you have a team of field technicians who must travel to different work locations. Look at how quickly the problem blows up:

1 mobile worker → **5 customers** → **120** Possible routes

1 mobile worker → **10 customers** → **3 million** Possible routes

(multiple mobile workers) → **1,000 customers** → **More routes than sand grains on Earth**
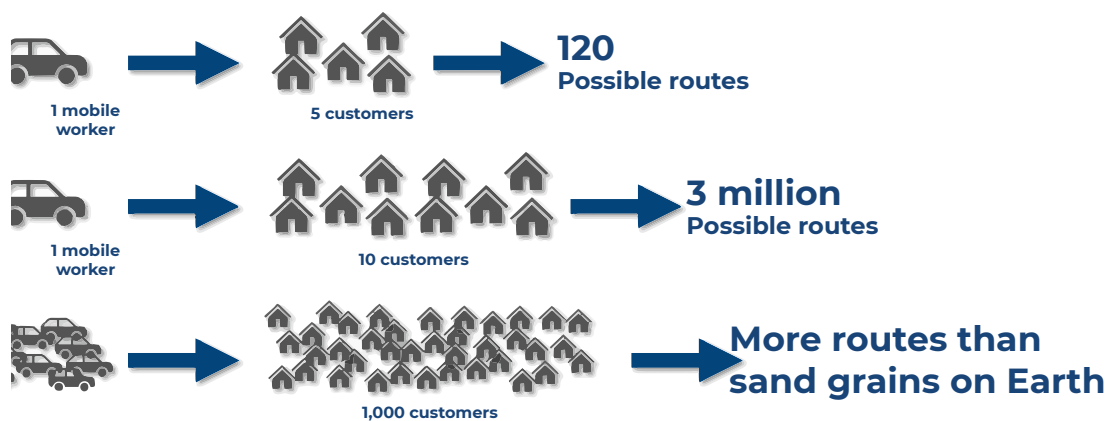
Figure 11: Optimization Problem Complexity

Add to this the need for interactivity and schedule shuffling. In the real world, jobs run late, workers don't show up and other such daily "fires" need constant tending. A scheduling system must enable the planner to make frequent changes, freeze parts of the schedule and re-plan other parts, either by hand or with a local re-optimization. This often requires some serious computer processing and algorithmic horsepower to do well.
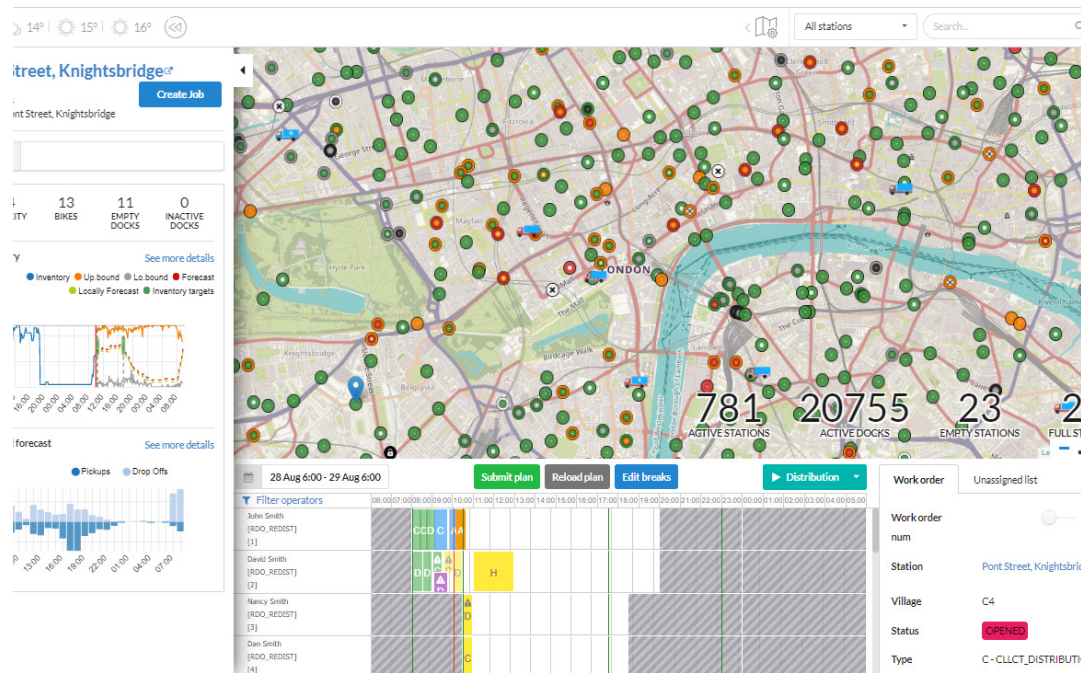
Figure 12: Route Optimization Dashboard

How to Achieve True Workforce Schedule Optimization

The industry "gold standard" **for solving hard workforce scheduling problems is to leverage mathematical optimization tools.** Airline crew scheduling applications, for instance, have for many years embedded such tools. Unfortunately, the vast majority of the scheduling software for most other industries and use cases is quite limited in optimization functionality.

Here are some important features to consider when looking for a workforce scheduling optimization system:

1. **Demand planning & forecasting** - so that you know how much of what types of work demand you'll have to satisfy with your schedule.
2. **Resource management** - ability to manage or at least integrate a detailed catalog of workers, skills, roles, availability, etc.
3. **Manual schedule adjustment** - to enable the user to make manual adjustments to the schedule if necessary.
4. **"Repair" the schedule** - to allow the user to perform a "local" repair, or re-optimization with minimal disruption to the overall schedule, in case unexpected events occur during the day.

The Complete Guide To Workforce Optimization

5.   **KPI management** - to track metrics like labor cost, resource utilization, overtime cost/hours, late jobs, service level, over and under staffing, late jobs, etc.

6.   **Executive dashboards** - preferably supports integration with other analytics & BI tools and allows easy export of all data.

7.   **Role-based workspaces** - so that users can access the appropriate data and functionality for their role.

8.   **Mathematical optimization engine** - inclusion of a reputable optimization "solver" or engine embedded in the tool. Simply ask, "Which optimization solver do you embed in your solution?". The vendor should respond with something like IBM CPLEX or Gurobi. If they talk about "rules" and "heuristics" or don't elaborate on the solvers that they embed, just know that the level of "optimization" and the flexibility in the factors that the system can consider will be quite limited.

9.   **On-demand, batched and regular schedule generation** - ability to create an optimized schedule at the push of a button, as part of a (nightly) batch process, or on a regular (e.g. hourly) scheduled basis.

10.   **Ability to also support tactical and strategic planning** - the best input to an operational schedule optimizer is a good tactical plan for the month. Similarly, the best input to a tactical plan optimizer is a good strategic plan. To achieve true global optimization, integration between these 3 functions is key. More about this in the next two blog posts.

11.   **Ease of integration with external systems** - scheduling optimization could be considered as an "intelligent" add-on module that sits on top of existing legacy systems (e.g. CRMs[Customer Relationship Management], CAFMs [Computer Aided Facilities Management], ERPs [Enterprise Resource Planning], or HR [Human Resources] systems, ...). In this case, the operational scheduling system must be easy to integrate with or at least exchange information with these systems.
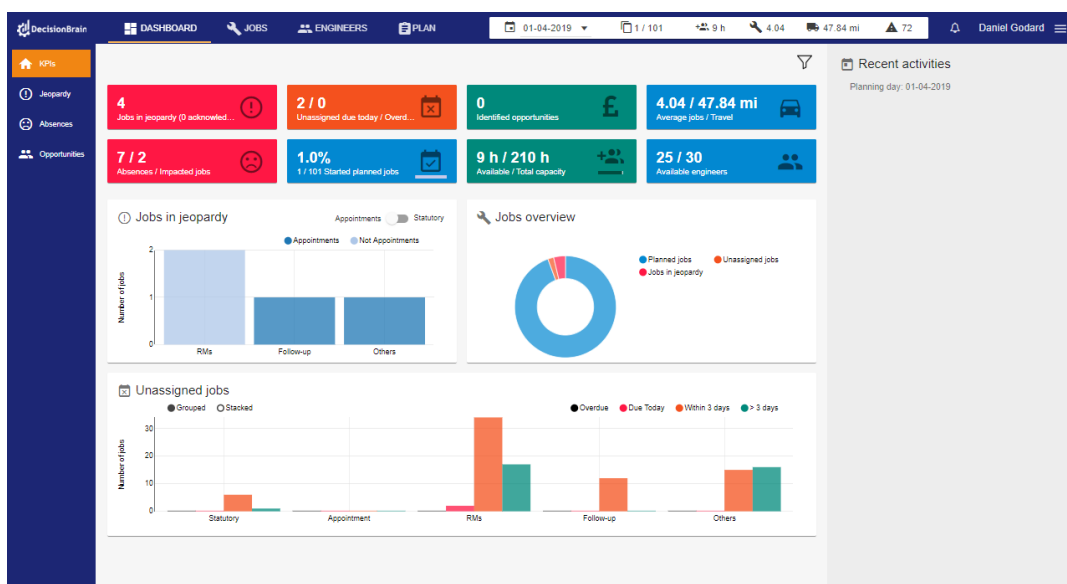

Figure 13: KPI Tracking

What if No System Meets My Exact Needs?

Scheduling problems are known to be harder to solve by off-the-shelf software applications, which is why many scheduling systems used by larger organizations are custom-developed, either as standalone systems or as bolt-ons to extend the functionality of other HR, FSM or CRM systems.

A hybrid approach does exist, and that is to leverage an application development platform - ideally one that is purpose-built for optimization (or operational planning or scheduling) use cases, such as DB Gene by DecisionBrain and Decision Optimization Center (DOC) by IBM.

Figure 14: DB Gene Platform Components

We at DecisionBrain use our DB Gene platform to deliver fully custom scheduling applications to our customers, typically in 3-7 months. That is thanks to DB Gene providing ~80% of the functionality needed for workforce scheduling optimization out of the box.

Part 5: Tactical Planning

In the previous section, we learned how to use all of this data to perform our first optimization step: Dynamic Scheduling. We talked about many of the important inputs to dynamic scheduling systems, including a demand forecast. Another very important input is a good tactical plan.

What is Tactical Planning?

Most organizations must meet a variety of obligations that are set on an annual basis. The specific arrangement or distribution of these activities throughout the year is what Tactical Planning focuses on. It is therefore considered to be a mid-term planning activity, in which decisions have an impact a few weeks to a few months out.

Tactical planning decisions are usually of two types:
- Distribution of planning activities to better cope with demand variability & seasonality
- Planning employee vacations, training and contractor utilization.

Planned Activity Distribution

Business uncertainties make it hard to precisely schedule certain activities a full year out, including those that are planned or recurring. For instance:
- A maintenance contract might require that equipment be serviced based on utilization metrics (e.g. every 4000 hours of oven utilization or every 2000 elevator door opens). Actual utilization will vary throughout the year so the service plan will need to be adjusted accordingly.
- Medical sales representatives may be required to visit doctors at a certain frequency, but cancellations are very common. It is therefore necessary to replan throughout the year to ensure that visit frequency targets are met.
- Equipment, materials, parts and/or supplies needed by construction crews may have availability limitations or could be disrupted for many reasons, e.g. shipping vessels or expensive excavation machinery may only be available to offshore or onshore construction workers at certain times of the year. Weather or other events may impact their availability, so rest-of-year plans need to be adjusted accordingly.

Tactical planning systems enable organizations to manage these uncertainties by regularly adjusting the plan over the impacted time horizon based on the latest ground truth (e.g. rolling 12 month plan for equipment maintenance planning or 1-mo plan for sales visit planning).

Below is a sample chart showing a capacity plan 1 month out in terms of level of demand satisfaction. Most of the time the total allocated workforce capacity (light bars) exceeds demand, which means there is adequate coverage for the first week. For the remaining 3 weeks in the month, the dark pink bars at the bottom show that, although there appears to be adequate total coverage, some tasks are actually undercovered because there are not enough workers with the right skills to meet the demand.
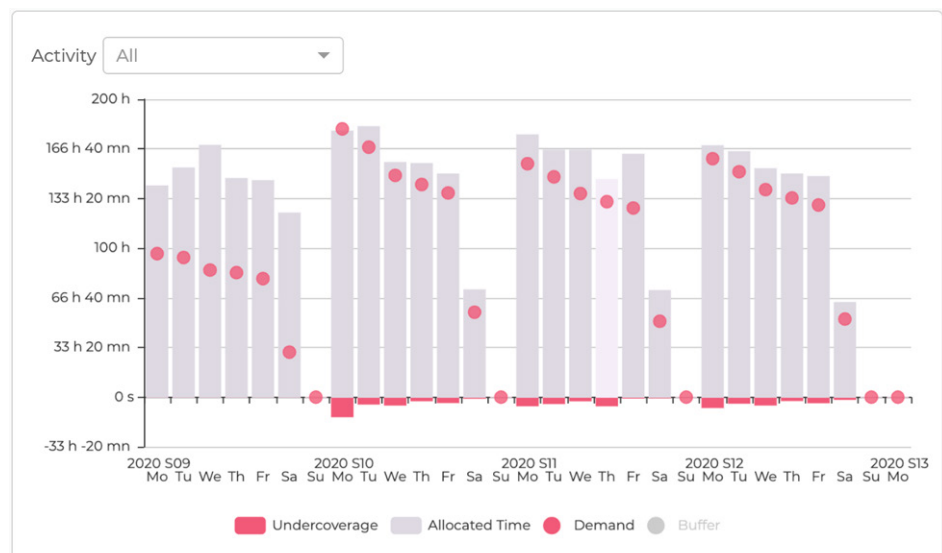

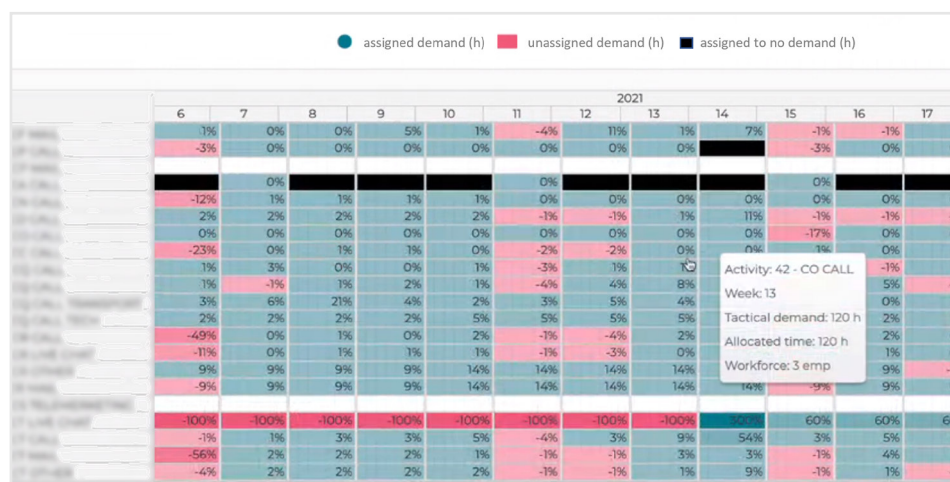Figure 15: One Month Tactical Workforce Capacity Plan

Figure 16: Tactical Workforce Demand - Gantt View

The Complete Guide To Workforce Optimization

Below is a more complex example of a tactical capacity plan, first before, then after optimization. The different colors represent different types of demand and therefore different employee roles. Notice the over-staffing in the first chart, depicted as white-space below the dark blue line. In the second chart, overstaffing has been reduced through optimization.
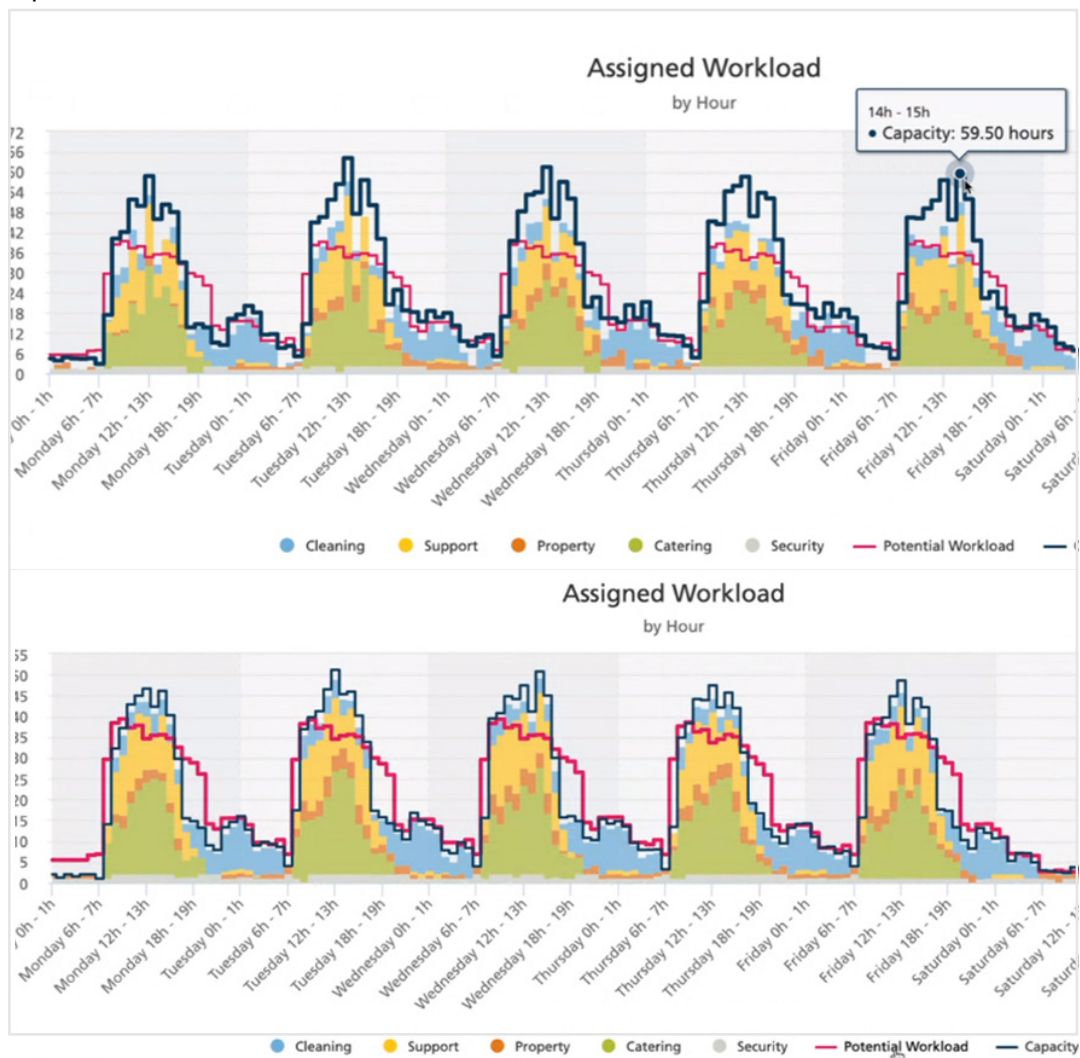

Figure 16: Monthly Capacity Plan Before & After Optimization

Planning Time Off, Training & Contractor Utilization

Just as certain planned and recurring customer and internal business activities can't be effectively scheduled a full year in advance, neither can employee time off, training sessions, or contractor utilization because it's hard to predict, for instance:

· When employees will request short-term time off
· When employees will require longer-term medical and parental leave
· When employees may resign or strike
· Major client contract acquisitions or terminations
· Certain compliance or training requirements

Greater planning agility throughout the year helps organizations operate more efficiently while also satisfying employees who appreciate greater flexibility in their schedules.

Reacting to the Unexpected with Tactical Planning

Since tactical planning is all about dealing with real-world uncertainties, how exactly are unexpected events handled? They can be handled multiple ways, depending on the extent of the disruption.

If the event causes a major operational disruption, it may be necessary to replan over the full time horizon since the effects could be felt over much or all of the month/year/ etc period. In some cases, it may also be worthwhile to relax some prior constraints because the new plan may be impossible to calculate under the prior constraints (or it could be a lot more complicated to compute). For instance, one could allow more overtime than usual or greater utilization of contractors.

If the disruption is minor, it may be possible to just locally repair the plan, perhaps by rescheduling a job and/or adjusting one person's usual route.

For a moderately significant disruption that falls somewhere in between the prior examples, one option could be to "freeze" certain parts of the plan and allow the system to replan everything else.

Anticipating Disruption with Preventative Measures

Several preventative measures can be taken in designing tactical plans so that unexpected events are less disruptive. For example:

- **Workload balancing & smoothing** - Tactical planning optimization software can be set up to smooth the workload over a time horizon. This allows more flexibility to tackle unexpected events on a given day. (See Figure below)
- **Buffers** - Deliberately adding some daily/weekly schedule buffer is another way to allow for uncertainty. That means not creating schedules that are too tightly packed.

26

- **Reducing Scheduling Granularity** - It's tempting to want to make the most detailed schedule possible, but some organizations take the opposite approach, for instance by assigning a set of activities over a full day, week or month and allowing the employees and their managers to be empowered to handle the scheduling details. It can also improve employee satisfaction because field staff may have preferences that the software system doesn't take into account.
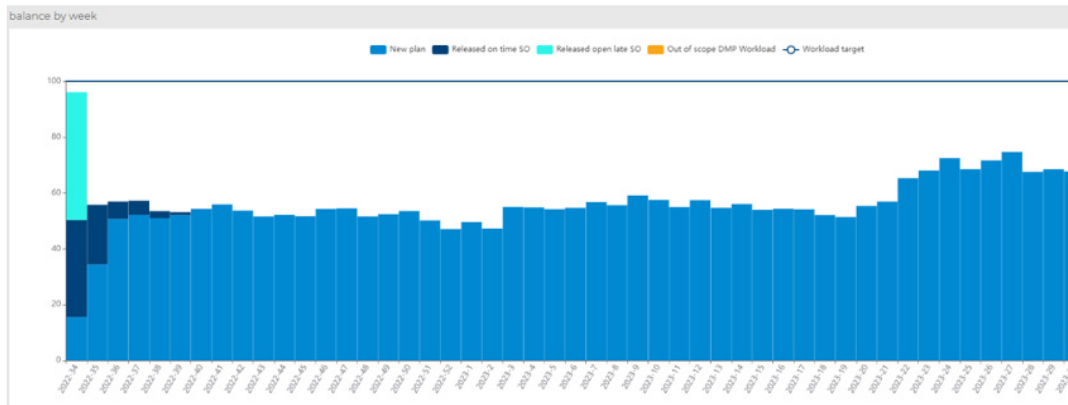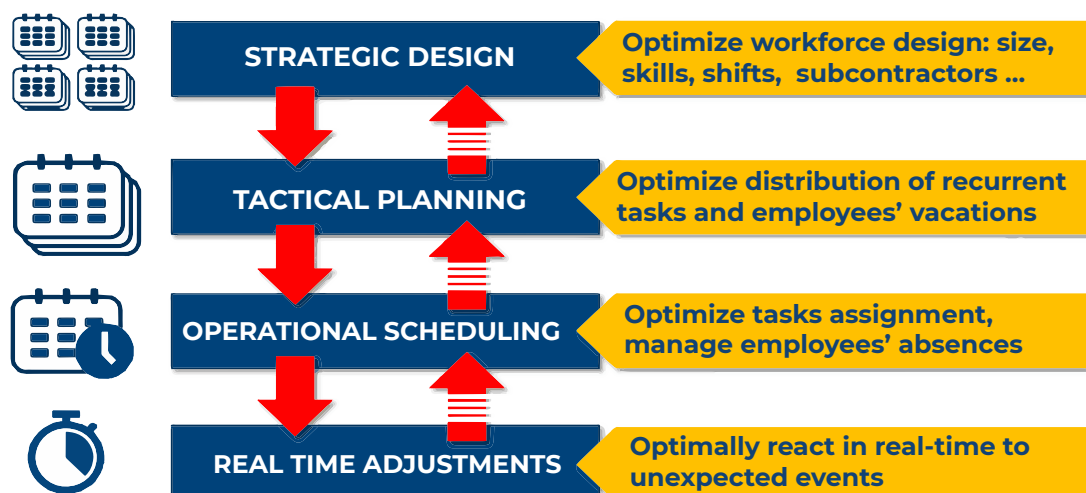

Figure 17: Workload Smoothing

Tactical Planning and Scheduling Go Hand-in-Hand

As mentioned earlier, tactical planning systems need to take into account the current reality on the ground.

Let's say a perfectly optimized tactical plan is created and it assigns 100 jobs to the field team. Then, when the operational scheduling system tries to optimize the routes, it may be discovered that 10% of the jobs can't be fulfilled, due perhaps to unusual traffic, equipment malfunction, employee illness or parts shortages.

To address this problem, the tactical planning and operational scheduling systems iterate back and forth, as shown below:

STRATEGIC DESIGN — Optimize workforce design: size, skills, shifts, subcontractors ...

TACTICAL PLANNING — Optimize distribution of recurrent tasks and employees' vacations

OPERATIONAL SCHEDULING — Optimize tasks assignment, manage employees' absences

REAL TIME ADJUSTMENTS — Optimally react in real-time to unexpected events

Scenario Testing for Resilience & Risk Management

Risk management is critical for any business and tactical planning systems can be used to help organizations prepare their workforces for certain anticipated but unlikely situations. This is best achieved through scenario analysis within tactical planning systems. Some of the questions that can be answered through scenario analysis include:

- **Demand Variability** - How well could I accommodate unusually high or lower demand of a certain type? How much buffer is necessary to ensure a good service level? How would my costs be impacted? Are temporary workers needed?
- **Step-changes in the demand** - What would be the impact of taking on certain additional work, such as expanding the scope of existing contracts or winning new ones? How could the workforce be restructured in case of loss of a contract?
- **Shift Design** - What would be the impact of modifying shift structures? Which alternate shifts should be assigned to employees in the next few months?
- **Skill Design** - Where do we have skills shortages? Which employees could be candidates for skills training? When is a good time to plan full-day training and how large should the groups be?
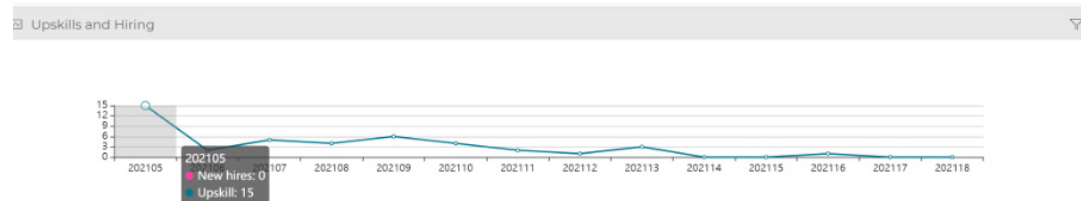

Figure 18: Training and hiring along weeks

- **Team Design** - Which main activities should be assigned to a team? Are any teams overstaffed or understaffed? What impact could task-team redistribution have?
- **Leave Design** - How should time off be distributed to minimize negative business impact?
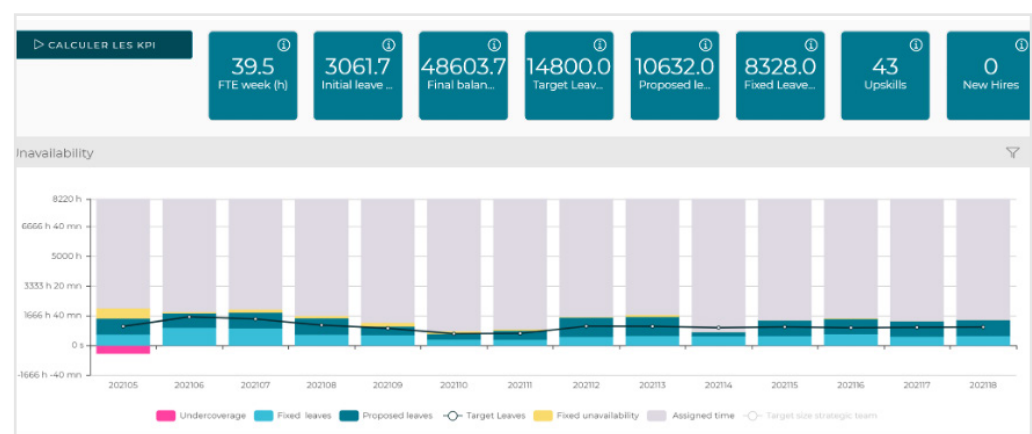

Figure 19: Employee unavailability

Example: Earthquake Disrupts Electrical Grid Provider's Operations

Let's imagine the case of an electrical energy provider that is planning and scheduling their field service team. An earthquake hits and causes damage to a portion of their grid infrastructure. A repair crew is quickly assembled and dispatched, thanks to the operational scheduling system. This crew might now include more contractors than had been previously planned. The total cost impact will be immediately known, thanks to KPI tracking in the schedule optimization system.

The job is expected to take a few weeks. This means that some previously scheduled maintenance work would be delayed or re-assigned, depending on the specific service level agreements (SLAs).
If this company has integrated a tactical planning system with their scheduling system, the new schedule and capacity plan would be sent to the tactical planning system, which would then "repair" the tactical plan for the next rolling 12-month period. After that, the new plan would be fed back into the scheduling system as the baseline for creating future weeks' schedules.

Given the latest work demand, the tactical planning system might suggest some high-level adjustments to future plans. Those changes could include postponing this team's maintenance work or moving some shifts. It might also pull forward some maintenance work that was previously scheduled a month or two out, but which can be efficiently completed in parallel with the repair work. The system could suggest these changes because it knows that the work is close by, the necessary equipment is available and the technicians have the needed skills to do this work.

Conclusion

Uncertainty is a fact of life, even more so in the post-pandemic era. Tactical planning optimization is one of the most overlooked opportunities for operational efficiency improvement. We at DecisionBrain have tackled this problem for various industries. Reach out to us if you'd like to discuss your particular planning and scheduling challenges.

Part 6: Strategic Planning

Why Discuss Strategic Workforce Planning Last?

In an ideal world, **Strategic Planning Optimization** happens first, before **Tactical Planning** and **Operational Scheduling**. There are several reasons for this. One is that no amount of tactical planning or operational scheduling can compensate for having the wrong workforce size, structure, or skill mix; variables that are defined during strategic planning. Another reason is that strategic changes can impact the way tactical planning and scheduling are performed, so optimizing the processes in the suggested order will minimize the total project implementation effort by reducing rework.

So then why is this section last? We changed the order of our sections to align with what we often see from our customers. As mentioned in Part 4, Operational Scheduling is usually tackled first because that's where the day-to-day pain is most acute, however, we advise to start with strategic planning before tactical planning or scheduling when possible.

What Exactly is Strategic Workforce Planning / Capacity Planning?

Strategic workforce planning, sometimes referred to as resource capacity planning, is about taking a long-term view on how best to build and structure the workforce so that the business can achieve both short-term and long-term business objectives while operating efficiently, predictably and smoothly. It also ensures the right balancing across customer satisfaction goals, employee preferences, and financial objectives. Other goals, like social or environmental targets, can also be considered.

At a high level, Strategic Workforce Planning focuses on answering questions like:

• **What is the right workforce size?** Number of people and job roles.

• **What is the right workforce configuration?** Having the required mix of skills and group/team structures to handle the needs of today and tomorrow

• **What will be the costs?** In order to achieve the business' service level targets, what will the business need to budget, or what will be the tradeoffs be between costs and service levels?

Strategic workforce planning activities are typically performed annually or whenever a significant change in business or services occurs, such as when a contract is lost or as a result of merger or acquisition. It can also be applied during the bidding process for a new contract to ensure an optimal bid response.

When done right, Strategic Planning enables the business to achieve both short-term and long-term business objectives while operating efficiently, predictably, and smoothly.

What Specific Questions are Answered by Strategic Workforce Planning?

Strategic Workforce Planning is a bit of a catch-all phrase that touches on many aspects of workforce management that we will not focus on in this article, as they are typically handled by Human Resources (HR) departments and not typically solved through optimization techniques. This includes talent management, succession planning and labor relations. This article is instead focusing on the operational side of Strategic Workforce Planning. More specifically we are focusing on answering questions like:

• **Workforce Design** - How many employees are needed? How should shifts and rosters be structured? Which in-demand skills are lacking? To what degree could cross-training alleviate the problem? Are temporary workers needed to cope with seasonality?

- **Work Center or Territory Design** - How large should the territory of each mobile employee be? What metric should be used to size territories? How exactly should the territory lines be drawn (see Figure 1 below)? What is the right balance between travel time and service time? What portion of the demand should be fulfilled by which team/employee?
- **Subcontracting Scope** - What would be the impact of subcontracting part of the workload vs developing the necessary skills in-house? What geographic and competency scope should subcontractors be responsible for?
- **Step-changes in the demand** - What would be the impact of taking on certain additional work, like expanding the scope of existing contracts or winning new ones? How to best restructure the workforce to cope with the loss of a contract?
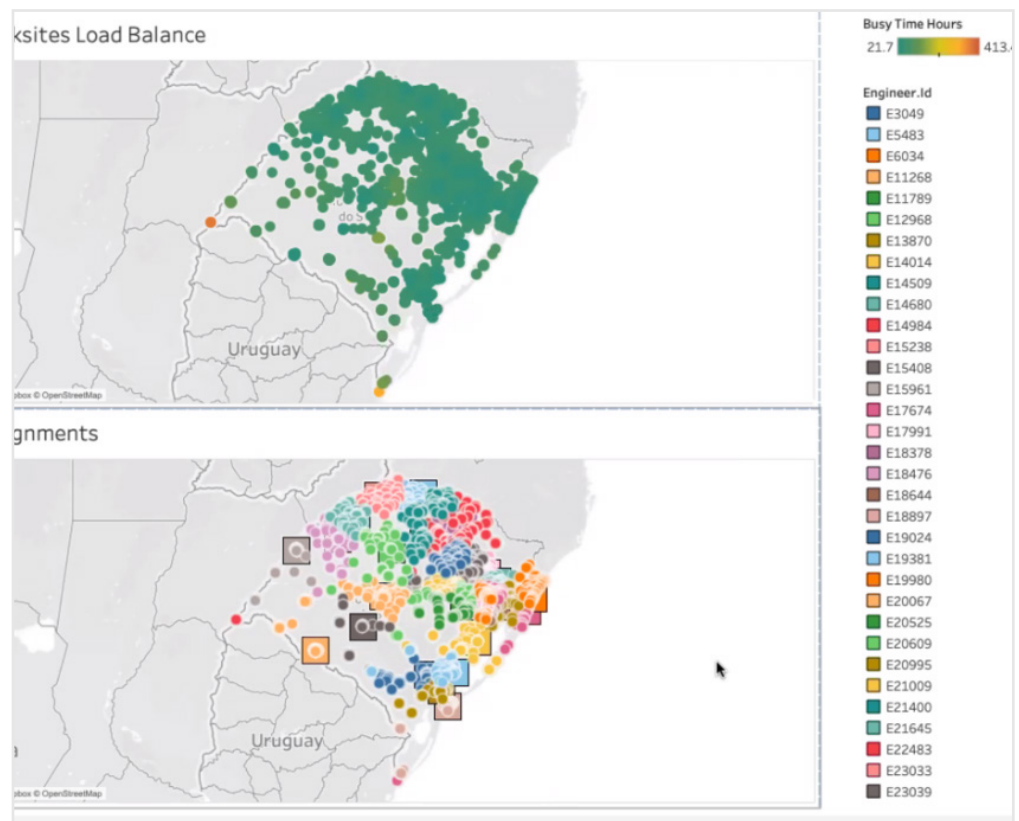

Figure 19: Optimized Territory Design

How to Achieve Strategic Workforce Optimization

Mathematical optimization techniques are well-suited for strategic workforce planning problems. That's because the number of possible territory layouts, workforce configurations, shift structures, etc. Can be on the order of millions or more.

Mathematical optimization algorithms are designed to take smart paths through the universe of possibilities, guided by knowledge of the objectives and constraints, and quickly arrive at an optimal or at least "very good" solution. Other techniques, such as business rules or simulations, for example, consider a significantly lower number of solution possibilities because they would take far too long to run given the same parameters.

Here are some important features to consider when looking for a strategic workforce optimization system - many of which are similar to those mentioned in the Workforce Scheduling Optimization section:

1.   **Demand planning & forecasting** - allows to accurately predict and model different work demand possibilities over a 1-3 year time horizon
2.   **Resource management** - ability to manage or at least integrate a detailed catalog of workers, skills, roles, etc.
3.   **Scenario management** - enable the planner to test and compare different possible plans
4.   **KPI management** - goes hand-in-hand with scenario management, KPIs are critical to evaluating the adequacy of plans based on metrics like cost, service level, fairness, environmental impact, etc.
5.   **Executive & interactive dashboards** - support integration with other analytics & BI tools and allow easy data export, perhaps also supporting some interactivity like selecting an area of a map
6.   **Role-based workspaces** - allow planners and leadership to access the appropriate data and functionality for their role
7.   **Mathematical optimization engine** - Inclusion of a reputable optimization "solver" or engine embedded in the tool. Simply ask, "which optimization solver do you embed in your solution?" The vendor should respond with something like IBM CPLEX, FICO Xpress or Gurobi. If they talk about "rules" and "heuristics" or don't elaborate on the solvers that they embed, just know that the level of "optimization" and the flexibility in the factors that the system can consider will be quite limited.
8.   **Support tactical planning and operational scheduling** - What good is a great strategic plan if you can't execute it effectively? This is why it's so important to be able to perform tactical planning with the strategic plan as input and then use the tactical plan as input into the operational scheduling system.
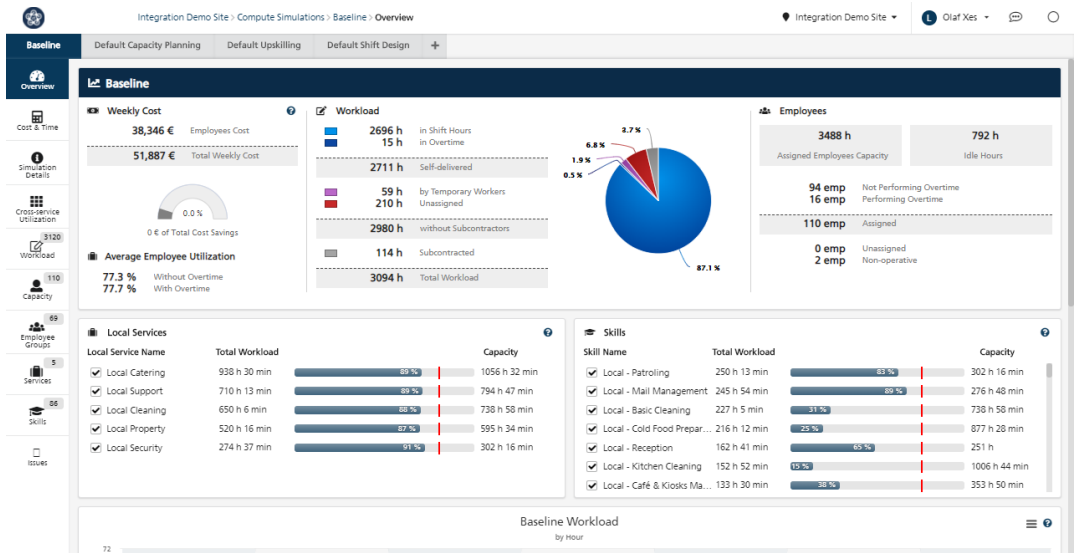
Figure 20: Sample Executive Dashboard with KPIs

Conclusion

By following the methods outlined in this 6-part guide, even in challenging and uncertain times, your organization can achieve global workforce optimization and outperform the competition.

Remember to take a look to the Skill Catalog template and to the Benchmarking template.

Contact us if you have any questions or want to discuss further!

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