



QAD Adaptive Applications

Training Guide MSW Leveling

70-3421-4.3
QAD Planning and Scheduling Workbenches
September 2019

This document contains proprietary information that is protected by copyright and other intellectual property laws. No part of this document may be reproduced, translated, or modified without the prior written consent of QAD Inc. The information contained in this document is subject to change without notice.

QAD Inc. provides this material as is and makes no warranty of any kind, expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. QAD Inc. shall not be liable for errors contained herein or for incidental or consequential damages (including lost profits) in connection with the furnishing, performance, or use of this material whether based on warranty, contract, or other legal theory.

This document contains trademarks owned by QAD Inc. and other companies.

Copyright ©2019 by QAD Inc.

MSWLeveling_TG_v043.pdf/sl8

QAD Inc.

100 Innovation Place
Santa Barbara, California 93108
Phone (805) 566-6000
<https://www.qad.com>

Contents

MSW Leveling Change Summary	vii
------------------------------------	------------

About This Course	1
--------------------------	----------

Course Description	2
Course Objectives	2
Audience	2
Prerequisites	2
Course Credit and Scheduling	3
Organization of Training Guide	3
Virtual Environment Information	3
Additional Resources	3
QAD Learning Center	3
QAD Document Library	3
QAD Support	4

Chapter 1 Introduction to Leveling	5
---	----------

Lesson Overview	6
What is Leveling	7
Leveling Objectives	8
Problem for Leveling	9
Sequencing Versus Leveling	10
MSW Example of Leveling	11
MSW Example Before Leveling	11
Leveling within the Production Schedule	12
Production Order Requirements	13
MSW Example After Leveling	14
Leveling	15
Leveling Business Case Examples	16
What Makes Leveling Effective	17

Chapter 2 Leveling Basics	19
----------------------------------	-----------

Lesson Overview	20
Basic Requirements for Leveling	21
Leveling within the Production Schedule	21

Basic Requirements	22
Leveling Using EPEI and Takt Time	23
Leveling, EPEI, and Takt time	23
EPEI	24
EPEI Example	25
EPEI Calculation	27
Takt Time Example and Calculation	28
Order Scheduling Performed Using Takt Time	29
Sequencing within Leveling Intervals	30
Scheduled Daily Capacity, Takt Time, and Scheduling	31
MSW Example of Leveling	32
Production Orders Across the Time Bucket	33
Required Capacity and Setup Time	34
Chapter 3 Leveling Horizon and Time Buckets	35
Lesson Overview	36
Leveling Horizon	37
Example of a Leveling Horizon	37
Leveling Horizon	38
Orders in the Leveling Horizon and Released Period	39
Time Buckets	40
Time Buckets for Leveling Calculations	40
Horizon Dates with Leveling Increment of Week	41
Time Buckets within a Scheduling Horizon	42
Full One-Week Time Buckets	43
Leveling Horizon and Time Bucket Examples	44
Example of Valve Assembly Production	44
Example of Robotic Equipment Production	45
Leveling Tips	46
Partial Time Buckets	47
Horizon Dates and Partial Week Time Buckets	47
Partial Bucket with Excluded Capacity and Production	48
Partial Bucket with Included Capacity and Production	49
Partial Bucket with Insufficient Capacity for Leveling	50
Chapter 4 MSW Leveling Details	51
Lesson Overview	52
Relationships Between the EPEI and Setup Time	53
EPEI and Number of Setups	53
EPEI with More Available Time for Setup	54
MSW Example	55
More Leveling Examples	57

Example: EPEI Leveling with 2 hours Available Capacity for Setup . .	57
Example: EPEI Leveling with 10 hours Available Capacity for Setup .	59
Leveling Intervals: Calculated EPEI and Minimum Interval Parameter	61
Leveling with EPEI	61
Minimum Interval Parameter for Production Line	62
Minimum Interval for Production Line Example	63
Minimum Interval Parameter for an Item	64
Minimum Interval Parameter for Item Example	65
Chapter 5 Leveling Setup.	67
Lesson Overview	68
Setting Up to Calculate the EPEI and Leveling	69
Required and Optional Setup	69
Required Setup for Production Lines and Items	70
Setup Option of a Kanban Process and Items	71
Kanban Process Item and Minimum EPEI	74
Required Calendars and Calendar Exceptions	75
Product Information Resources	77

MSW Leveling Change Summary

Product Name Changes

Starting in September 2019, the new name for QAD's complete portfolio of products is QAD Adaptive Applications. Additionally, QAD Adaptive ERP is the new name for QAD's flagship ERP solution. QAD Adaptive ERP includes the functionality previously associated with QAD Cloud ERP and QAD Enterprise Applications - Enterprise Edition, plus the QAD Enterprise Platform and Adaptive UX which resulted from the Channel Islands program. Going forward, the terms QAD Enterprise Applications, QAD Cloud ERP, and Channel Islands will be deprecated but will remain in previous documentation and training materials. QAD's intention is to—as soon as possible—eliminate the use of the deprecated terms going forward.

Change Summary

The following table summarizes significant differences between this document and the last published version.

Date/Version	Description	Reference
September 2019/2019EE	Initial release of document	--

About This Course

Course Description

This course provides training upon the leveling functionality in the Planning and Scheduling Workbenches for Production Orders. It focuses on the general introduction, basic concepts, setup, and examples of leveling. For more information about the leveling features, you can refer to the user guide for QAD Planning and Scheduling Workbenches for Production Orders.

Course Objectives

The overall objectives of the course are to provide a basic background in MSW leveling.

This training guide is organized with several chapters, and each chapter includes a list of learning objectives for the topics covered in that chapter.

By the end of this training, you should be able to:

- Understand the basic concepts related to leveling, including but not limited to EPEI, takt time, minimum interval, leveling horizon, and time bucket.
- Describe the relationships:
 - Between the leveling horizon and time buckets
 - Between the EPEI, the time available for setup, and number of setups
 - Between the EPEI and the preset minimum interval
 - Between planned capacity, required capacity, setup time, excess capacity, and scheduling
- Set parameters to determine the leveling horizon and time buckets, and calculate the EPEI and takt time.
- Understand the general processes of leveling.
- Set up and operate the leveling functions.

This course is not intended to take the place of implementation training or consulting. The complete body of knowledge required to make the business decisions required for system setup and implementation is beyond the scope of this course.

Audience

This course is intended for:

- Business analysts
- Implementation managers
- Production schedulers
- Production managers
- Operations managers

Prerequisites

An understanding of basic manufacturing principles is beneficial.



Course Credit and Scheduling

This course is valid for 4 credit hours.

Organization of Training Guide

There are five main chapters in this training guide:

- Introduction to Leveling
- Leveling Basics
- Leveling Horizon and Time Buckets
- MSW Leveling Details
- Leveling Setup

Key concepts are discussed at the beginning of each chapter to familiarize you with processes, work flows, and terminology. For example, in Chapter 3, “Leveling Horizon and Time Buckets,” concepts discussed include leveling horizon and time buckets.

Virtual Environment Information

The hands-on exercises in this book should be used with the latest QAD Adaptive ERP learning environment.

When prompted to log in, specify demo for user ID and qad for password. In general, students are more comfortable with static data they are familiar with such as currencies and addresses. However, it is up to the instructor to decide which exercise set to use, depending on the audience.

Additional Resources

If you encounter questions on QAD software that are not addressed in this book, several resources are available. The QAD corporate Web site provides product and company overviews. From the main site, you can access the QAD Learning or Support site and the QAD Document Library.

Access to some portions of these sites depends on having a registered account.

<https://www.qad.com/>

QAD Learning Center

To view available training courses, locations, and materials, use the QAD Learning Center. Choose Education under the Services tab to access this resource. In the Learning Center, you can reserve a learning environment if you want to perform self-study and follow a training guide on your own.

QAD Document Library

To access release notes, user guides, training guides, and installation and conversion guides by product and release, visit the QAD Document Library. Choose Document Library under the

Support tab. In the QAD Document Library, you can view HTML pages online, print specific pages, or download a PDF of an entire book.

To find a resource, you can use the navigation tree on the left or use a powerful cross-document search, which finds all documents with your search terms and lets you refine the search by book type, product suite or module, and date published.

QAD Support

Support also offers an array of tools depending on your company's maintenance agreement with QAD. These include the Knowledgebase and QAD Forums, where you can post questions and search for topics of interest. To access these, choose Visit Online Support Center under the Support tab.

Chapter 1

Introduction to Leveling

Lesson Overview

Objectives

- Describe the essential problem solved for leveling
- Describe the objectives of leveling.
- Identify business cases and scenarios when leveling can be applied.
- Describe factors for effective leveling.

What is Leveling

Introduction to Leveling

- From the Japanese, leveling reduces “unevenness” (**Mura**), which in turn reduces “waste” (**Muda**).
- Use leveling to create a schedule with smaller production intervals and more frequent production orders, to smooth requirements within the production scheduling horizon.
- The leveling process determines the mix, sequence, and flow of production, to create a schedule that can be supported by production resources.



4

From the Japanese, leveling reduces “unevenness” (Mura), which in turn reduces “waste” (Muda). The Planning and Scheduling Workbenches provide the capability to level production orders for a production line, to create a schedule with smaller production intervals and more frequent production orders, to smooth requirements within the production scheduling horizon.

Reduced variability, a level schedule with small production intervals, leads to simpler material and capacity planning. The leveling process determines the mix, sequence, and flow of production, to create a schedule that can be supported by production resources.

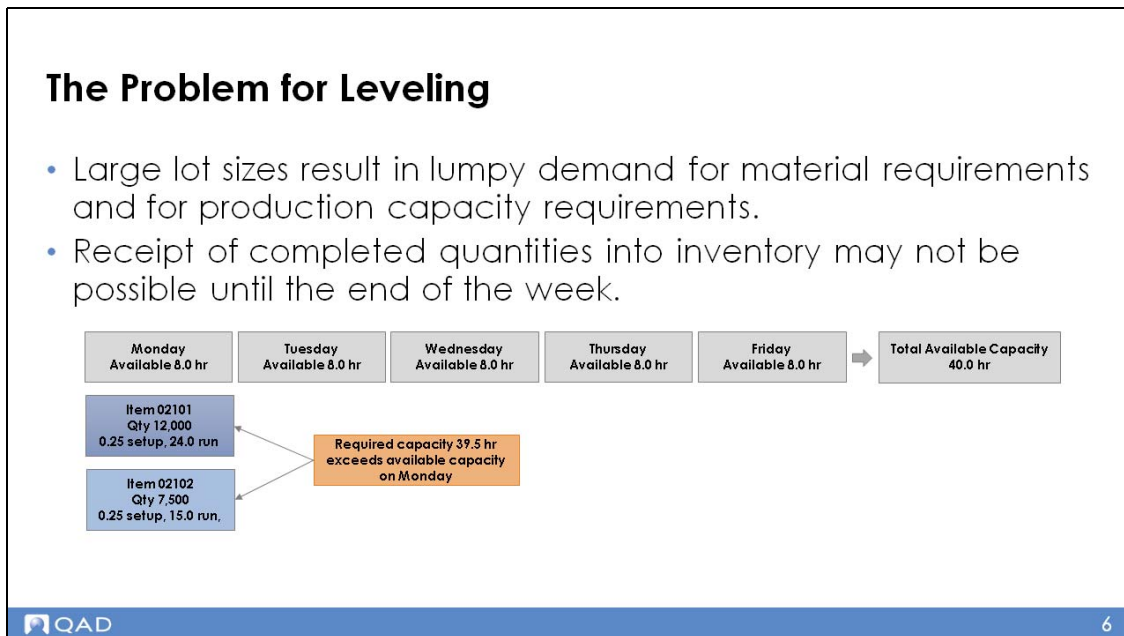
Leveling Objectives

Leveling Objectives

- Create a regular and constant rate of production.
- Smooth the production of items to increase responsiveness to changing customer demand and the product availability to satisfy that demand.
- Reduce the variability of demand for materials and the capacity requirements for production resources across time.
- Reduce inventory while decreasing both production lead time and order promising lead time.

The primary objective of leveling is to reduce the variability of demand for materials and the capacity requirements for production resources.

Problem for Leveling



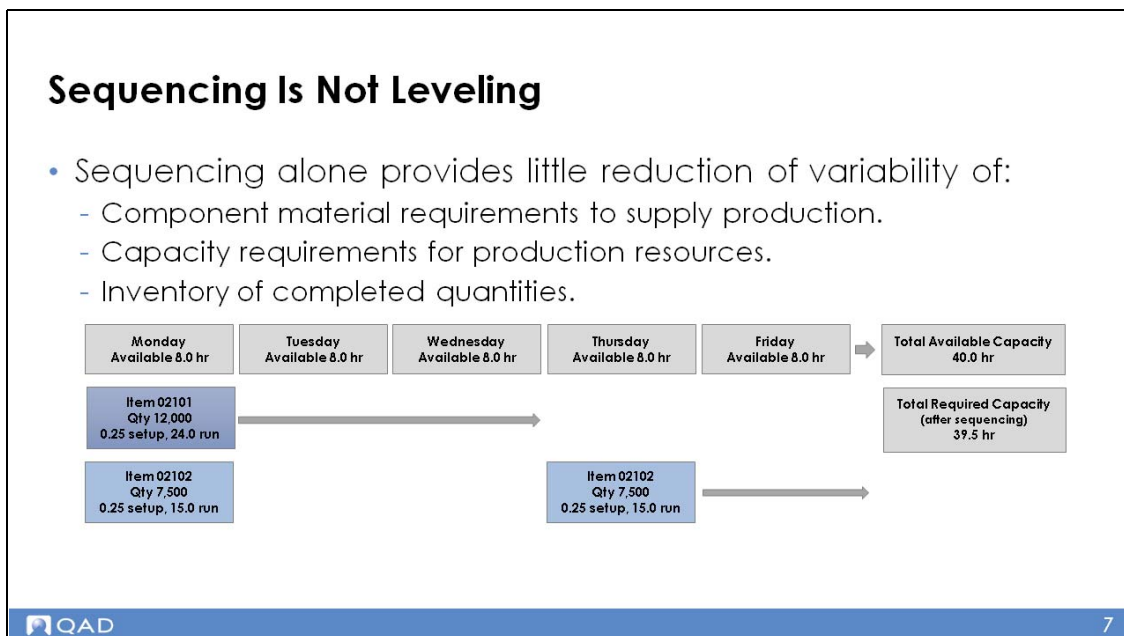
The primary reason for leveling production stems from the fact that production schedules are uneven. This presents fluctuations in the demand for production resources, demand that can often exceed the capacity for any given day.

What causes uneven schedules? To begin with, the master schedule may contain production orders that are scheduled by week, with a status of being Firm or Planned, for material requirements planning and rough-cut capacity planning. While this may be acceptable within the master schedule horizon, the production schedule may require production orders that are scheduled more frequently, to level the demand for component materials, and to balance the load on production lines and work centers.

A typical master schedule is stated as a weekly quantity usually due on the first day of the week. Since the master schedule is a series of production orders for different items, it usually means that all the material requirements for all components are due on the same date and all the capacity requirements for shared resources are on that date as well.

The degree to which demand and capacity variability can be reduced depends on spreading the master schedule quantities over the week, instead of bunching them on a single day. Yet, if the process of spreading master schedule quantities is limited to moving large lot sizes, over the course of the week, the component requirements and capacity requirements may still be lumpy. This lumpiness can only be reduced by taking more steps to reduce the lot sizes, and as a result reduce the “production interval,” the amount of time it takes to get back to the first item in the production sequence.

Sequencing Versus Leveling



The process of sequencing production orders within a time bucket is not the same as leveling. Sequencing is not leveling. This explains why the problem of uneven schedules is not solved by the simple re-sequencing of orders. Sequencing alone provides little reduction of variability or “lumpiness” of material requirements and capacity requirements.

MSW Example of Leveling

MSW Example Before Leveling

MSW Example Before Leveling

- The first week contains orders for 2 items scheduled on Monday.

Master Scheduling										
Capacity		02100								
Production Line	Horizon End	Record Type	Past Due	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
02100	02/15/2019	Remaining Capacity	0	-23.4	8	8	8	8	0	0
		Planned Capacity	0	8	8	8	8	8	0	0
		Required Capacity	0	31.4	0	0	0	0	0	0
		Scheduled Quantit	0	31000	0	0	0	0	0	0
		Cumulative Capac	0	0.6	8.6	16.6	24.6	32.6	32.6	32.6
Schedule										
Activity	Production Lin	Item Number	Nettable Q0	Past Due	01/21	01/22	01/23	01/24	01/25	01/26
Yes: 02100		02101			16000					
Yes: 02100		02102			15000					

This example shows the production line schedule before leveling, the parameters for leveling, and the schedule after leveling.

There are two items with one order scheduled on the first day of the week. The 31.4 hours of required capacity for that day exceeds the 8.0 hours of planned capacity.

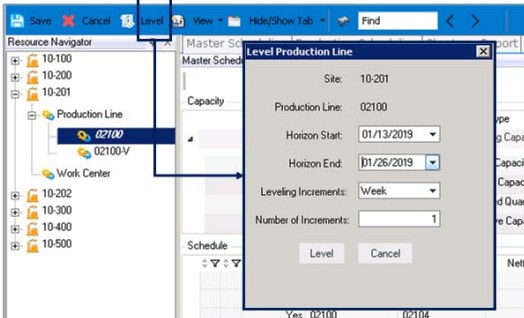
Leveling within the Production Schedule

Leveling within the Production Schedule

Master Production Schedule

Production Schedule

- Level to create a schedule with smaller production intervals and more frequent production orders, to smooth requirements within the production scheduling horizon.



Leveling can be applied to a two-week leveling horizon.

Within the production scheduling horizon, you can:

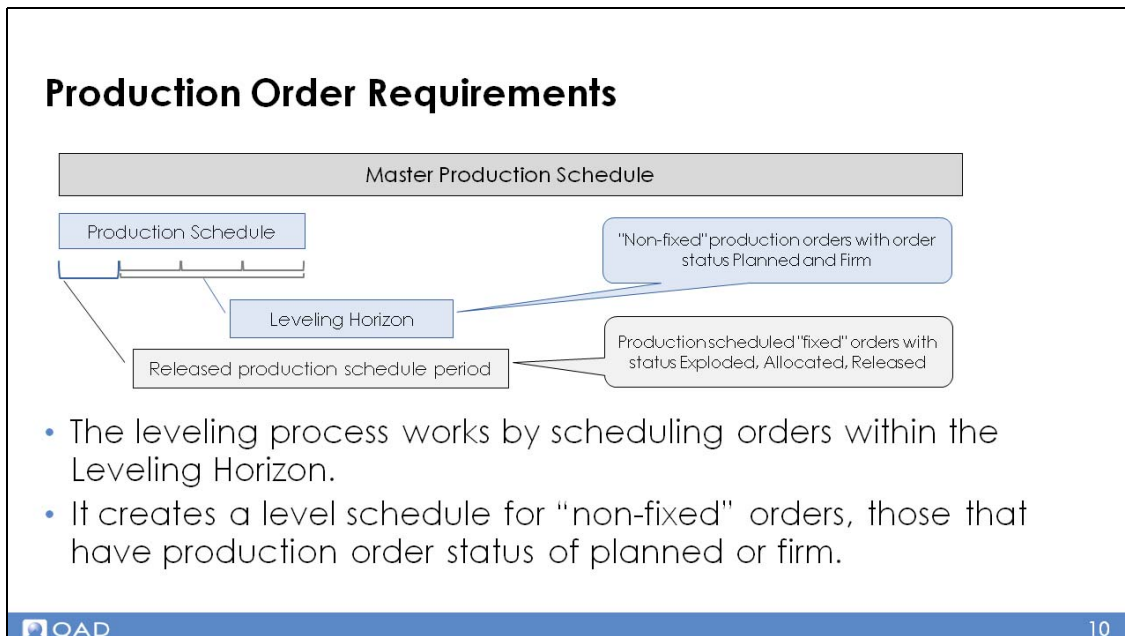
- Create a schedule with smaller production intervals and more frequent production orders to smooth requirements.
- Level the demand for component materials.
- Balance the load on production lines.

Master production schedule:

- Contains production orders that extend to the end of the horizon, that may be scheduled by week, resulting in lumpy requirements for materials and production resources.
- Supports rough-cut capacity planning.

Note Extending the leveling horizon beyond the production schedule may result in excessive processing times.

Production Order Requirements



Leveling schedules production orders within the Leveling Horizon.

The leveling process works by creating a level schedule from “non-fixed” orders, those that have production order status of planned or firm.

It does this by splitting and/or sequencing the orders to create a level schedule within a scheduling bucket.

When the leveling horizon contains both “fixed” orders—those that have production order status of exploded, allocated, or released—together with “non-fixed” orders, the leveling process first loads the fixed orders using backward scheduling, then it loads and automatically level schedules the non-fixed orders.

To assure consistent application of measures so as to determine how schedules are leveled, all of the items on a production line must be either:

- Kanban items identified with a Kanban Process that is identifiable with the production line, or
- Non-Kanban and Kanban items that are not identified with a Kanban Process that is identifiable with the production line.

MSW Example After Leveling

MSW Example After Leveling

- Leveling schedules orders to spread the requirements over each day within the time bucket.

Master Scheduling											
Capacity		02100									
Production Line	Horizon End	Record Type	Past Due	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Week 4
02100	02/15/2019	Remaining Capacity	0	1.4	1.4	1.4	1.4	1.4	0	0	7
Planned Capacity			0	8	8	8	8	8	0	0	40
Required Capacity			0	6.6	6.6	6.6	6.6	6.6	0	0	33
Scheduled Quantity			0	6200	6200	6200	6200	6200	0	0	31000
Cumulative Capacity			0	25.4	26.8	28.2	29.6	31	31	31	31
Schedule											
Activity	Production Line	Item Number	Nettable QD	Past Due	01/21	01/22	01/23	01/24	01/25	01/26	01/27
Yes	02100	02101			3200	3200	3200	3200	3200		16000
Yes	02100	02102			3000	3000	3000	3000	3000		15000

In this example, the production orders created during leveling spread across a week for each item.

Leveling

Leveling

- Leveling reduces the variability of demand for materials and the capacity requirements for production resources.
- Reduced variability leads to simpler material and capacity planning.



The effectiveness of leveling is directly related to the degree that production intervals can be reduced. Physical and process improvements to the production process, as well as setup time reduction, are particularly required to achieve this.

Leveling Business Case Examples

Leveling Business Case Examples

- Commonly used with Lean manufacturing, Kanban, make-to-stock (MTS) items, and finish-to-order (ATO).
 - Automotive valve assemblies
 - High volume production of 12 different products.
 - Daily shipments to customer's final assembly plants.
 - Industrial robotic equipment
 - Low volume production of 8 models.
 - Shipments every 1-2 weeks to distribution centers.



Leveling is commonly used with lean manufacturing, Kanban, make-to-stock (MTS) items, and finish-to-order (ATO) items.

Leveling is frequently done for Finish-to-Order (Assemble-to-Order) situations where planning is done through planning bills of material, and could be done for MTO/ETO situations where there are a few “model” bills of material that are used for planning component materials when having a customer order or an engineering design.

What Makes Leveling Effective

What Makes Leveling Effective?

- Effectiveness is directly related to the degree that production intervals can be reduced.
 - The ultimate objective is to get to the shortest possible interval.
 - Physical and process improvements to the production process, particularly setup time reduction are required to achieve this.
- Smallest production interval is called the EPEI.
 - EPEI (every part every interval) is an **interval** during which every item can be setup and produced within a time bucket.
 - EPEI is calculated from the time available for production, the current setup time for each part, and the current run time for each part.



14

By creating a production environment in which each item is produced as needed, in the smallest possible quantities, you achieve a regular drumbeat, eliminating the lumpiness of component requirements as well as the lumpiness of capacity requirements, simplifying the process of both inventory replenishment and capacity planning.

The value of EPEI is determined by:

- Available capacity for the production line
- Required run time for the scheduled item and quantities
- Setup time for items

A time bucket of one week might have an EPE interval of 0.5 week, where all items are produced twice a week.



Chapter 2

Leveling Basics

Lesson Overview

Objectives

- Identify the basic requirements for leveling.
- Describe the calculation and impact of EPEI.
- Describe the calculation and impact of takt time.
- Describe the impact of maximum daily capacity on scheduling.
- Describe the relationship between required capacity and setup time.

Basic Requirements for Leveling

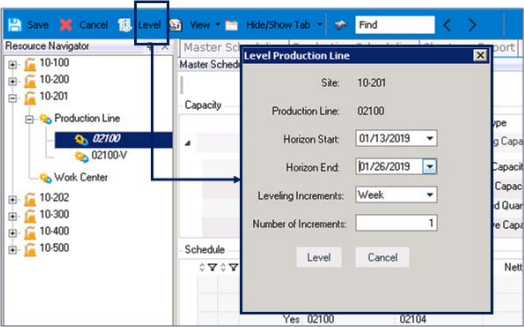
Leveling within the Production Schedule

Leveling within the Production Schedule

Master Production Schedule

Production Schedule

- Level to create a schedule with smaller production intervals and more frequent production orders, to smooth requirements within the production scheduling horizon.




4

Within the production scheduling horizon, you can:

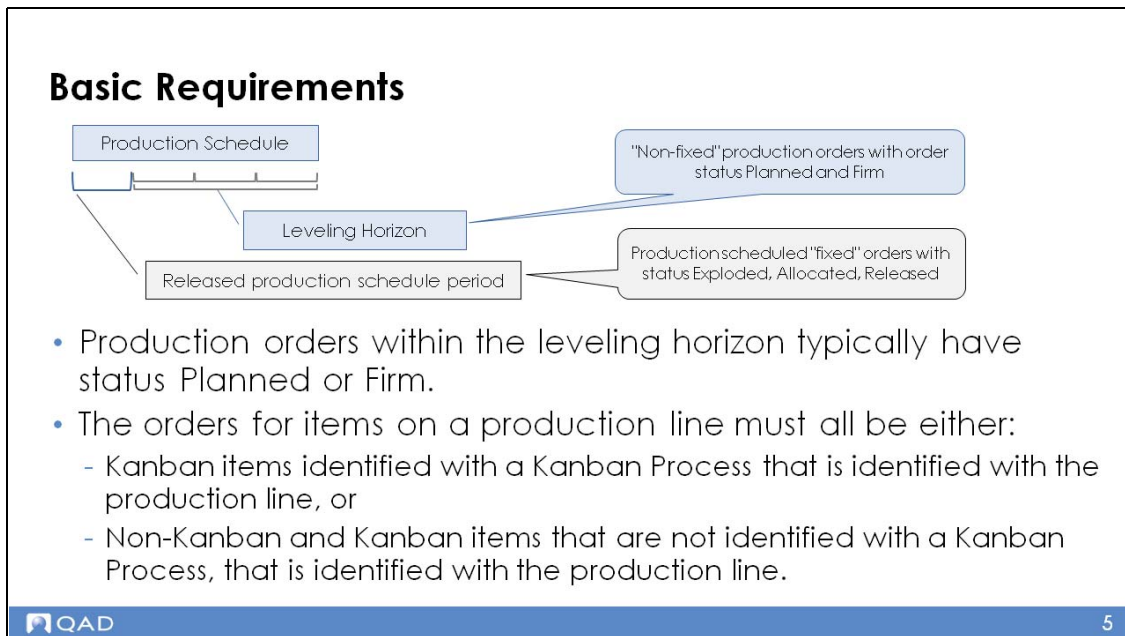
- Create a schedule with smaller production intervals and more frequent production orders to smooth requirements.
- Level the demand for component materials.
- Balance the load on production lines.

Master production schedule:

- Contains production orders that extend to the end of the horizon, that may be scheduled by week, resulting in lumpy requirements for materials and production resources.
- Supports rough-cut capacity planning.

Note Extending the leveling horizon beyond the production schedule may result in excessive processing times.

Basic Requirements



To assure consistent application of measures to determine how schedules are leveled, the production orders for all of the items that are scheduled on a production line must be either:

- Non-Kanban and Kanban items that are not identified with a Kanban Process that is identified with the production line, or
- Kanban items identified with a Kanban Process that is identified with the production line.

The production orders within the leveling horizon should primarily consist of “non-fixed” orders, those with production order status Planned or Firm.

The leveling process works by creating a level schedule from “non-fixed” orders.

It does this by splitting and/or sequencing the orders to create a level schedule within a scheduling bucket.

When the leveling horizon contains both “fixed” orders—those that have production order status of exploded, allocated, or released—together with “non-fixed” orders, the leveling process first loads the fixed orders using backward scheduling, then it loads and automatically level schedules the non-fixed orders.

Leveling Using EPEI and Takt Time

Leveling, EPEI, and Takt time

Leveling, EPEI, and *Takt* time

- Leveling
 - Minimizes lot sizes and while increasing the number setups while not exceeding the available capacity of a production line.
 - Determines **EPEI**, the smallest interval that every item, scheduled for production, can be set up and produced within a time bucket.
 - Schedules items to be set up and produced the same number of times (intervals) within a time bucket using ***takt* time**.

QAD

7

The effectiveness of leveling is directly related to the degree that production intervals can be reduced. Physical and process improvements to the production process, as well as setup time reduction, are particularly required to achieve this.

By creating a production environment in which each item is produced as needed, in the smallest possible quantities, you achieve a regular drumbeat, eliminating the lumpiness of component requirements as well as the lumpiness of capacity requirements, simplifying the process of both inventory replenishment and capacity planning.

The smallest production interval is called Every Part Every Interval (EPEI). EPEI is an interval during which every item can be set up and produced within a time bucket. It is calculated from the time available for production, the current setup time for each part, and the current run time for each part.

Scheduling is performed using takt time rather than setup and run (or cycle) time.

EPEI

EPEI

- Key to leveling.
- Called EPEI for every part every interval.
- Determined from the available time for the production line, the run time for each part, the required quantities, and the setup time for each part.

QAD

8

EPEI is the smallest possible interval during which every item can be set up and produced within a time bucket.

Determining the value of EPEI is the key to leveling. The value of EPEI is determined by:

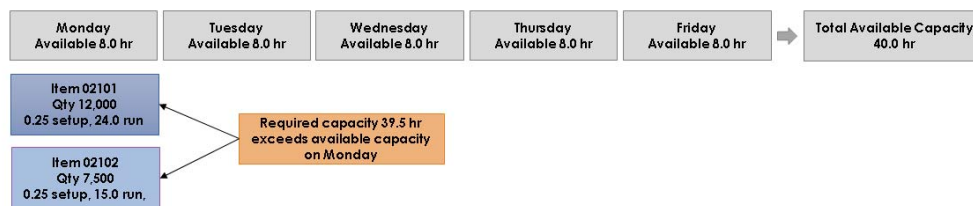
- Available capacity for the production line
- Required run time for the scheduled item and quantities
- Setup time for items

There is a way to determine the smallest possible interval and the lot size for each MPS item—using the time available, the current setup time for each part, and the current run time per part.

EPEI Example

Introductory Example

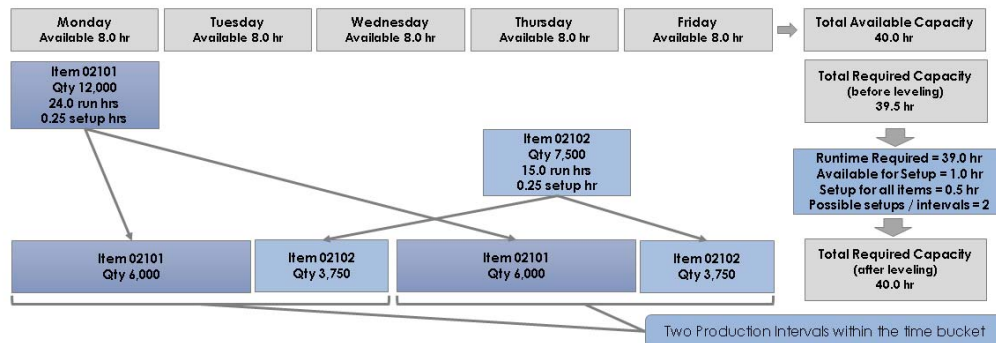
- Two orders for items scheduled on the same day.
- Required capacity is slightly less than capacity for the week.
- Required capacity exceeds that available on Monday.
 - Component are required all at once.
 - Nothing is scheduled for 4 days.



During the 144,000 seconds within the 40 hours of time bucket, there will be 19,500 units produced, one unit each 7.38 seconds (or each 0.00205128 hours).

EPEI Example

- Two EPE intervals calculated from the available capacity, runtime, and setup time for the scheduled quantities.



Using leveling to calculate the every part every (EPE) interval—the size of the interval that every item, scheduled for production on a production line, can be set up and produced within a time bucket.

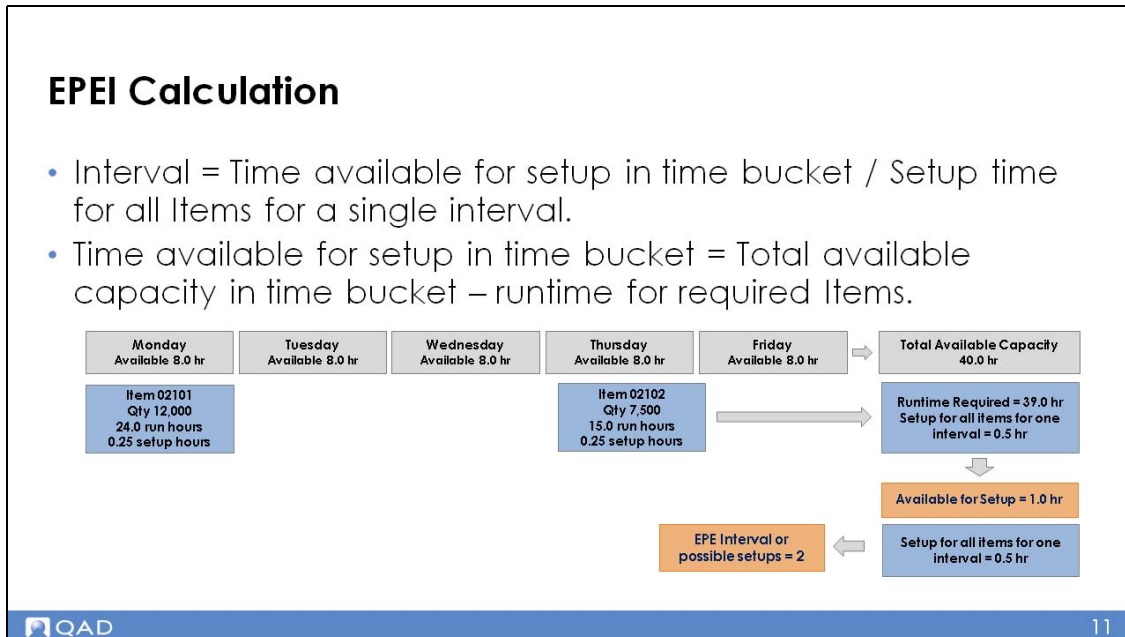
The interval, the value of EPEI, is determined using:

- Available capacity for the production line

- Required run time for the scheduled item and quantities
- Setup time for items

More detailed examples for EPEI are included in “More Leveling Examples” on page 57.

EPEI Calculation



EPEI is calculated from the available capacity for the production line, the time required for fixed orders, the required quantities and run time for non-fixed orders, and the setup time per unit for all non-fixed orders items. It can be expressed as:

$$EPEI = \text{Time available for setup of non-fixed orders} / \text{Setup time (per unit) for all non-fixed order items}$$

where,

$$\text{Time available for setup of non-fixed orders} = \text{Available capacity for non-fixed orders} - \text{Runtime for non-fixed order quantities}$$

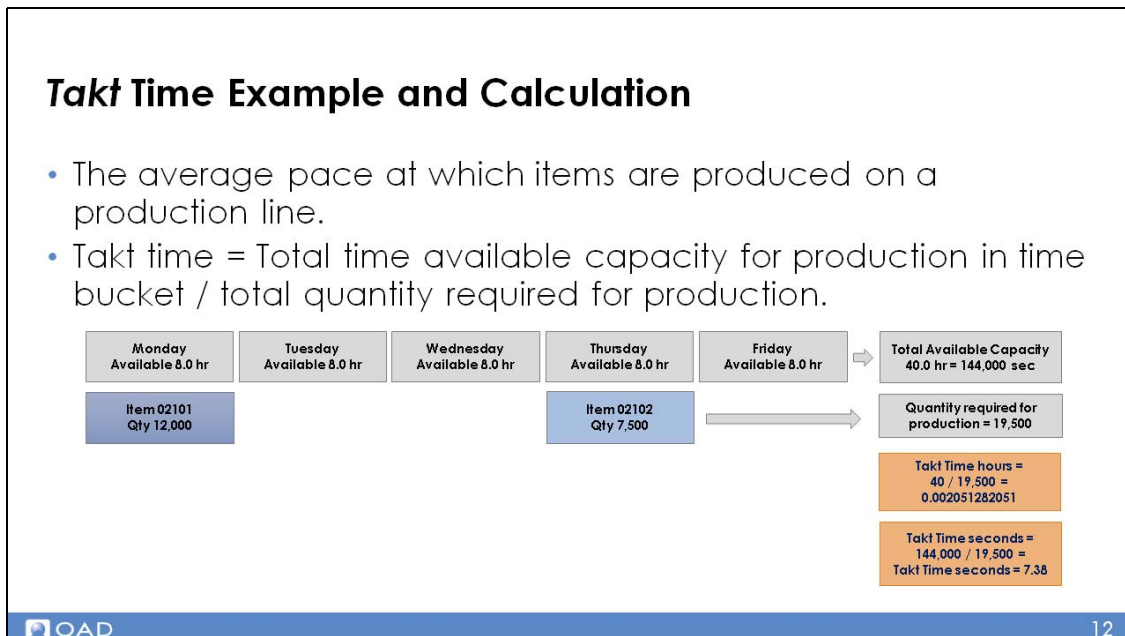
and

$$\text{Available capacity for non-fixed orders} = \text{Total available capacity} - \text{Setup and runtime required for fixed order quantities}$$

In detail, EPEI is calculated as:

$$EPEI = (\text{Total available capacity in time bucket} - \text{Setup and runtime required for fixed order quantities} - \text{Runtime required for non-fixed order quantities}) / \text{Setup time (per unit) for all non-fixed order items}$$

Takt Time Example and Calculation



Takt time is the average pace at which items are produced on a production line. It can be expressed as:

Takt time = Total time available capacity for production in time bucket / Total quantity required for production (for both fixed and non-fixed orders)

Leveling schedules orders using takt time within intervals calculated for a scheduling bucket.

Takt time is also used to determine the maximum quantity that can be produced on a day, where:

Daily maximum quantity = Daily available time / Takt time

The daily maximum quantity can alternatively be expressed as:

Daily maximum quantity = Total quantity required for production / Number of working days in a time bucket

Order Scheduling Performed Using Takt Time

Order Scheduling Performed Using Takt Time

- Leveling schedules orders using *Takt* time within EPE intervals.

Monday Available 8.0 hr	Tuesday Available 8.0 hr	Wednesday Available 8.0 hr	Thursday Available 8.0 hr	Friday Available 8.0 hr	⇒ Total Available Capacity 40.0 hr
Item 02101 Qty 6,000 12.3 Takt hours	Item 02102 Qty 3,750 7.7 Takt hours	Item 02101 Qty 6,000 12.3 Takt hours	Item 02102 Qty 3,750 7.7 Takt hours	Total Quantity 19,500 Takt Time 0.002051282051	

Order scheduling within intervals is determined using takt time rather than the setup or run time.

Takt time is calculated using the time available and the quantity required (and not directly impacted by setup or run time).

Sequencing within Leveling Intervals

Sequencing within Leveling Intervals

Monday
Available 8.0 hr

Tuesday
Available 8.0 hr

Wednesday
Available 8.0 hr

Thursday
Available 8.0 hr

Friday
Available 8.0 hr

Total Available Capacity
40.0 hr

Item 02101
Qty 4,000
12.3 Takt hours

Item 02102
Qty 3,750
7.7 Takt hours

Item 02101
Qty 4,000
12.3 Takt hours

Item 02102
Qty 3,750
7.7 Takt hours

Total Quantity 19,500
Takt Time
0.002051282051

Site: 10-201 Lean Manufacturing Site
Process: FA Final Assembly

Item Number	Step	UM	UM Conv	Kanban Qty	SM Site	SuperMkt
02101	0	EA	1.0000	100.0	10-201	FGI
02102	0	EA	1.0000	100.0	10-201	FGI
02103	0	EA	1.0000	100.0	10-201	FGI

Item: 02101 Step: 0 Mfg Seq R: 1

EPEI: 0.061
EPEI Auto: ☒
Min EPEI: 0.000
Yield: 100.00%
Start Op: 0 End Op: 10
Req Oper: 0.0

Setup Time (D H M S): 0 00 12 00
Cycle Time (D H M S): 0 00 00 01 00 00
Work Time (D H M S): 0 00 00 07 10 00
Lead Time (D H M S): 0 00 00 00 00 00
Move Time (D H M S): 0 00 00 00 00 00
Equipment Time (D H M S): 0 00 00 00 00 00

Item Number: 02104 EA Valve Assembly 1
Site: 10-201 Lean Manufacturing Site
Production Line: 02100 Valve Production

Units/Hour: 1,000.00
Setup (D H M S): 0 00 30 00
Start: 10/23/2018

Run Sequence 1: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

The production of items within an interval is sequenced by:

- Mfg Seq for Kanban Process and ite
- Run Sequence setup for the item and production line
- Item number

Use Kanban Process Maintenance to set the value for the Mfg Seq parameter for an item.

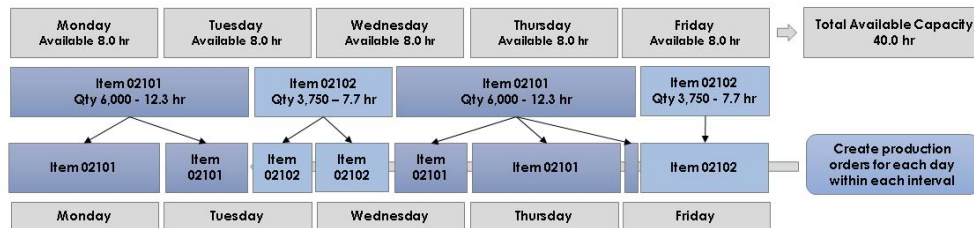
Use Item Production Line Maintenance to set the value for the Run Sequence parameter for an item on a production line.

Note For Kanban items, the system considers the Run Sequence setup in Item Production Line Maintenance instead of Mfg Seq in Kanban Process Maintenance.

Scheduled Daily Capacity, Takt Time, and Scheduling

Scheduled Daily Capacity, Takt Time, and Scheduling

- Required capacity for the quantities scheduled for a day cannot exceed scheduled capacity.
 - Required capacity determined using the setup and run time.
 - When production of an item within an interval spans more than one day, leveling creates orders for each day.



QAD

15

Takt time is used to level production orders and to determine the maximum quantity that can be scheduled for a day, as follows:

$$\text{Daily maximum quantity} = \text{time available for the day} / \text{Takt time}.$$

The daily maximum quantity can also be expressed as:

$$\text{Daily max quantity} = \text{Total quantity required for production} / \text{Number of working days in a time bucket}.$$

Important When the production of an item spans more than one day, it results in multiple production orders. Be especially careful not to confuse the **number of production orders** created for an item, with the **number of intervals** the item within a time bucket.

MSW Example of Leveling

MSW Example Before Leveling

- The first week contains orders for 2 items scheduled on Monday.

Master Scheduling												
Capacity		02100										
Production Line	Horizon End	Record Type	Past Due	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Week 4	
02100	02/15/2019	Remaining Capacity	0	-31.5	8	8	8	8	0	0	0.5	
		Planned Capacity	0	8	8	8	8	8	0	0	40	
		Required Capacity	0	39.5	0	0	0	0	0	0	39.5	
		Scheduled Quantity	0	19500	0	0	0	0	0	0	19500	
		Cumulative Capacity	0	-7.5	0.5	8.5	16.5	24.5	24.5	24.5	24.5	
Schedule												
Activity	Production Line	Item Number	Nettable QD	Past Due	01/21	01/22	01/23	01/24	01/25	01/26	01/27	01/28
Yes: 02100		02101			12000							
Yes: 02100		02102			7500							

MSW Example After Leveling

- Leveling schedules orders to spread the requirements over each day within the time bucket.

Master Scheduling												
Capacity		02100										
Production Line	Horizon End	Record Type	Past Due	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Week 4	
02100	02/15/2019	Remaining Capacity	0	-0.1	-0.1	-0.1	0.2	-0.1	0	0	0	
		Planned Capacity	0	8	8	8	8	8	0	0	40	
		Required Capacity	0	8	8	8	8	8	0	0	40	
		Scheduled Quantity	0	3900	3900	3900	3900	3900	0	0	19500	
		Cumulative Capacity	0	24	23.9	23.9	24.1	24	24	24	24	
Schedule												
Activity	Production Line	Item Number	Nettable QD	Past Due	01/21	01/22	01/23	01/24	01/25	01/26	01/27	01/28
Yes: 02100		02101			3900	2100	1950	3900	150			
Yes: 02100		02102			1800	1950		3750				

Production Orders Across the Time Bucket

Production Orders Across the Time Bucket

- Maximum daily capacity is recognized when scheduling orders.

Required Capacity and Setup Time

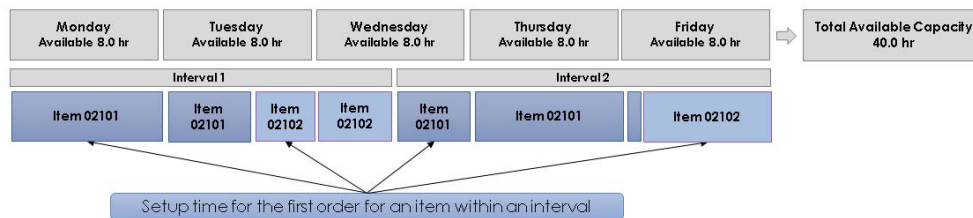
Required Capacity and Setup Time

- In the Master Scheduling Workbench
 - The required capacity for each day is determined by the setup and run times for orders.

Master Scheduling												
		%a	02100									
Capacity												
	Production Line	Horizon End	Record Type	Past Due	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Week
▲	02100	02/07/2019	Remaining Capacity	0	1	1	1.2	1	1	0	0	5.2
			Planned Capacity	0	8	8	8	8	8	0	0	40
			Required Capacity	0	7	7	6.8	7	7	0	0	34.8
			Scheduled Quant	0	6200	6200	6200	6200	6200	0	0	31000
			Cumulative Capac	0	33	34	35.2	36.2	37.2	37.2	37.2	37.2

Required Capacity and Setup Time

- In the Master Scheduling Workbench
 - The setup time is applied at the start of the item, the first order, and not on orders scheduled on the following days.



The required capacity for each day is determined by the setup and run times for orders. When the production of an item within an interval spans more than one day, setup time is included in the first order for the item within the interval. Other orders for the item within the interval do not include setup time.

Chapter 3

Leveling Horizon and Time Buckets

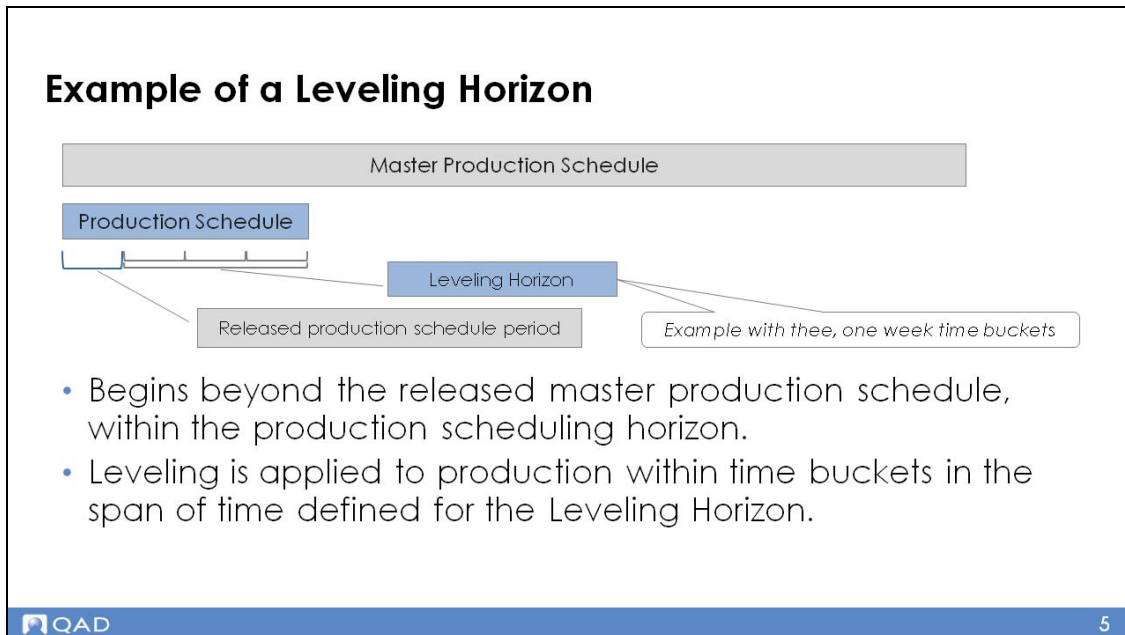
Lesson Overview

Objectives

- Describe the leveling horizon and the scheduling of "non-fixed" orders.
- Set parameters to determine the leveling horizon.
- Set parameters to determine the time bucket.
- Describe the relationship between the leveling horizon and time buckets.
- Describe the impact of the leveling horizon and performance.
- Identify tips that should be applied when leveling.

Leveling Horizon

Example of a Leveling Horizon



Leveling is applied to production within time buckets in the span of time defined for the Leveling Horizon.

The leveling horizon is a span of time that begins beyond the released master production schedule, within the production scheduling horizon. The leveling horizon is a period during which leveling calculations are performed and orders can be automatically scheduled using the MSW, defined by the Horizon Start and Horizon End dates.

The released production schedule period preceding the leveling horizon consists of production orders that are “fixed” and scheduled manually, with status Exploded, Allocated, and Released.

Extending the leveling horizon beyond the production schedule may result in excessive processing times.

Important Although the Horizon End date may extend to the end of the Master Production Schedule, the processing time to complete the calculations for EPEI and leveling is likely to be excessive.

A time bucket is:

- A period inside the leveling horizon within which calculations are performed
- A time span determined by Leveling Increments and Number of Increments

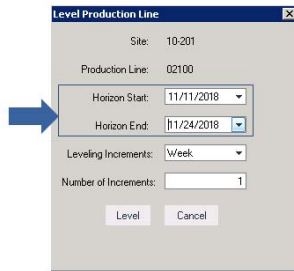
Example

- Beyond the current week, if there is a one-week frozen period
- Including the first three weeks following the frozen period

Leveling Horizon

Leveling Horizon

- The period over which leveling is performed.
- The scheduling horizon is determined by the horizon start and horizon end dates.



The leveling horizon is determined by Horizon Start and Horizon End dates, together with the number and size of time increments (daily, weekly, monthly), specified by the Level Production Line parameters.

When using an increment of Week, set the Horizon Start date to a day that corresponds to the day defined in MRP Control (23.24) for the Summary Default day parameter, and set Horizon End date to a day that corresponds to the day prior to the Summary Default.

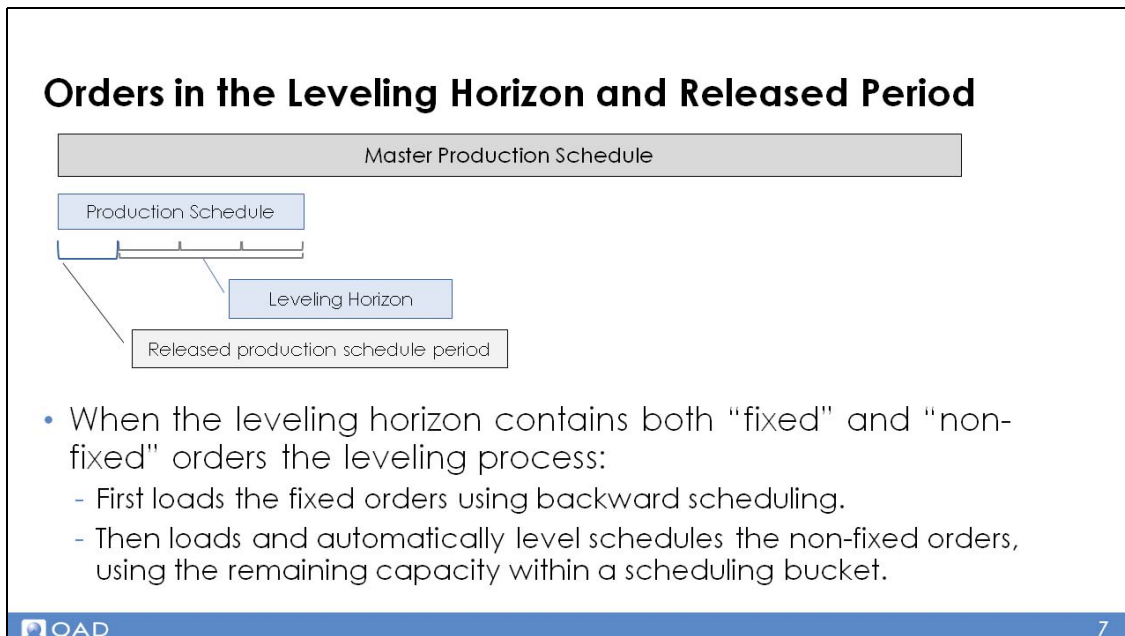
Select the Level button on the MSW/PSW to set the parameters for leveling a production line:

- Horizon Start cannot be before the current date.
- Horizon End cannot be after the end of the MPS horizon.

The end of the MPS horizon is determined by choosing Option|Preferences on the MSW, then updating values in History Horizon and Future Horizon.

Important Although the Horizon End date may extend to the end of the Master Production Schedule, the processing time to complete the calculations for EPEI and leveling is likely to be excessive.

Orders in the Leveling Horizon and Released Period



Leveling schedules production orders within the Leveling Horizon.

The leveling process works by creating a level schedule from "non-fixed" orders, those that have production order status of planned or firm.

When the leveling horizon contains both "fixed" orders—those that have production order status of exploded, allocated, or released—together with "non-fixed" orders, the leveling process first loads the fixed orders using backward scheduling, then it loads and automatically level schedules the non-fixed orders.

When the leveling horizon contains both "fixed" and "non-fixed" orders, the leveling process:

- 1 First loads the fixed orders using backward scheduling.
- 2 Then loads and automatically level schedules the non-fixed orders, using the remaining capacity within a scheduling bucket.

Time Buckets

Time Buckets for Leveling Calculations

Time Buckets for Leveling Calculations

- The size of the time bucket is the multiple of the leveling increment and the number of increments.
 - Time period increment, corresponding to a day, week, or month.
 - Number of increments that that make up a time bucket.

The leveling horizon typically contains “non-fixed” production orders with status Planned or Firm that can be automatically rescheduled by the leveling process.

It is preceded by the released production schedule period which contains “fixed” production orders—order status Exploded, Allocated, and Released—that are not automatically rescheduled.

Note In reality, the MSW leveling horizon within the production schedule and the master production schedule may in fact have “fixed” orders with status Exploded, Allocated, and/or Released.

A future version supports leveling with fixed and non-fixed orders together.

Time buckets for the leveling calculation are determined by the unit of time period, corresponding to a day, week, or month, together with the number of increments (days, weeks, or months) that are needed to make up a time bucket.

The size of the time bucket is the multiple of the leveling increment and the number of increments.

- Leveling Increments: Select Day, Week, or Month to determine the unit for a time bucket.
- Number of Increments:
 - Enter the number of increments that make up a single time bucket.
 - Enter 1 if the time bucket is a single day, week, or month.
 - Enter 0 if the entire MPS horizon is one significant bucket.

Horizon Dates with Leveling Increment of Week

Horizon Dates with Leveling Increment of Week

- When using an increment of Week, set the Horizon Start date to a day that corresponds to the day defined in MRP Control (23.24) for the Summary Default day parameter, and set Horizon End date to a day that corresponds to the day prior to the Summary Default.

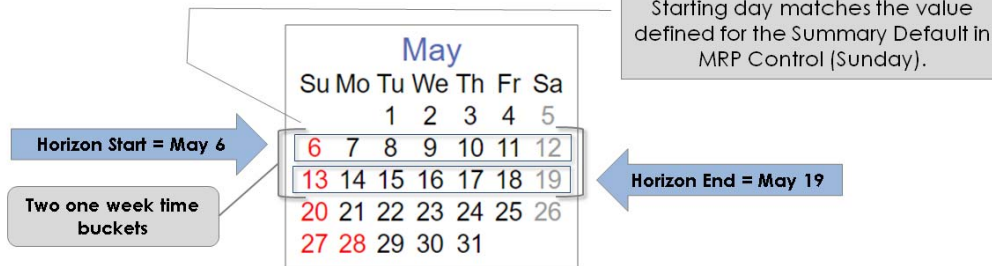
The image shows two screenshots from the QAD software interface. On the left is the 'Level Production Line' dialog box. It contains fields for 'Site' (10-201), 'Production Line' (02100), 'Horizon Start' (11/11/2018), 'Horizon End' (11/24/2018), 'Leveling Increments' (Week), and 'Number of Increments' (1). A blue arrow points to the 'Leveling Increments' dropdown. On the right is the 'MRP Control' window, which shows 'MRP Horizon' (60), 'MRP/DRP Combined' (checked), 'Summary Default' (Sunday), 'Order Release Horizon' (7), 'Enable Op Based Yield' (unchecked), and 'Use AppServer' (checked). A blue arrow points from the 'Leveling Increments' dropdown in the first window to the 'Summary Default' field in the second window.

The default starting day for a 7-day—or one-week—leveling bucket is determined by the value defined for the Summary Default day in MRP Control (23.24).

Time Buckets within a Scheduling Horizon

Time Buckets within a Scheduling Horizon

- Within the scheduling horizon, between the horizon start and end dates, there can be more than one time bucket.
 - Leveling increment = Week
 - Number of increments = 1

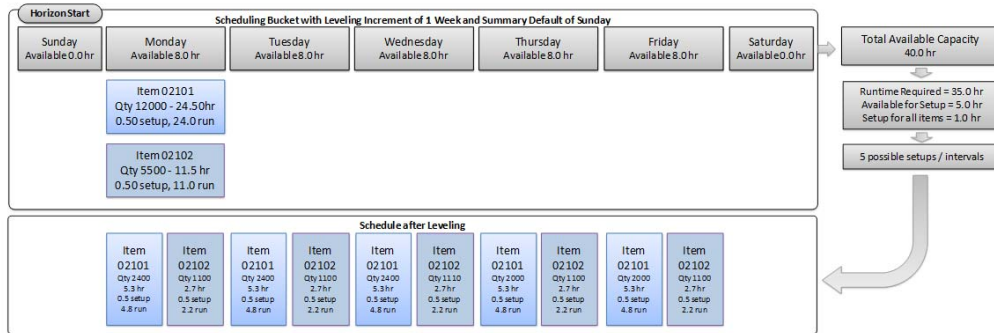


In this example, the scheduling horizon consists of two one-week leveling buckets. Each bucket consists of 7 days. The starting date for each bucket falls on Sunday, the Summary Default date defined in MRP Control.

Full One-Week Time Buckets

Full One Week Time Buckets

- Summary Default day and the Horizon Start day align.
- Includes capacity and production for the one week period.



QAD

12

The figure shows how orders scheduled at the beginning of a week are leveled over the one-week period beginning on Sunday (the Summary Default date).

The time bucket includes the capacity and production for all of the days within the one-week period.

Leveling Horizon and Time Bucket Examples

Example of Valve Assembly Production

Example of Valve Assembly Production

- Production characteristics
 - Short manufacturing lead time (seconds to minutes).
 - Short setup times (less than 10 minutes), minimal changes to direct the frequent delivery and flow of components materials.
 - Low inventory of component materials that have short lead times and frequent replenishment.



Valve Assembly Leveling

- Scheduling objectives
 - Level production from weekly quantities to produce all items multiple times through the week, if not daily.
 - Create level schedules for each of one week period following the current week.
 - Released master production schedule period up to 1 week.
 - Leveling horizon 2 weeks.
 - Time bucket for 1 week leveling intervals.

Production Schedule

Level Production Line

Site: 10-201

Production Line: 02100

Horizon Start: 01/13/2019

Horizon End: 01/26/2019

Leveling Increments: Week

Number of Increments: 1

Level Cancel

Settings for 1 week
time buckets

Example of Robotic Equipment Production

Example of Robotic Equipment Production

- Production characteristics
 - Moderate manufacturing lead time (multiple hours).
 - Longer setup times (up to 4 hours), moderate changes to direct the flow of components materials.
 - Moderate to high inventory of component materials that have moderate lead times and less frequent replenishment.



Robotic Equipment Leveling

- Scheduling objectives
 - Level production from weekly or monthly quantities to produce all items at least once every 2 weeks.
 - Create level schedules for the 4 weeks following the current week.
 - Released master production schedule period up to 1 week.
 - Leveling horizon 4 weeks.
 - Time bucket for 2 week leveling intervals.



Level Production Line

Site: 10-201

Production Line: 02100

Horizon Start: 01/13/2019

Horizon End: 02/09/2019

Leveling Increments: Week

Number of Increments: 2

Level Cancel

Settings for 2 week
time buckets

Leveling Tips

Important Leveling Tips

- ⚠ Use leveling when scheduled production and its required capacity does not exceed the planned (available) capacity for a production line.
- ⚠ Exercise caution when the available capacity is much higher than the required capacity:
 - To avoid a schedule that consists of many orders for an item within a day.
 - Setup items with a Kanban Process and a defined minimum EPEI to prevent level scheduling with many orders with small quantities for each day.

Leveling Horizon and Performance



- ⚠ Extending the leveling horizon beyond the production schedule may result in excessive processing times.

Extending the leveling horizon beyond the production schedule may result in excessive processing times. Although there may be reasons to level the entire master production schedule, the processing time may not be acceptable.

Partial Time Buckets

Horizon Dates and Partial Week Time Buckets

Horizon Dates and Partial Week Time Buckets

⚠ A partial bucket with fewer than 7 days may appear at the beginning and/or end of a scheduling horizon.

- The calculation of EPEI and takt time, and leveling are determined for a period that is shorter than a full time bucket.

Horizon Start = May 1

May						
Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Available capacity and production outside of an abbreviated week are not recognized

Horizon End = May 31

QAD 21

Be careful to select values for the Horizon Start and Horizon End dates that correspond to the Summary Default day when using increments based on “week,” to avoid partial time buckets. When there is a partial time bucket, the calculation of EPEI and takt time, and leveling are determined for a period that is shorter than a full-time bucket. It does not recognize the available capacity and production that fall on days that fall outside of the partial time bucket that would otherwise fall within a full-time bucket.

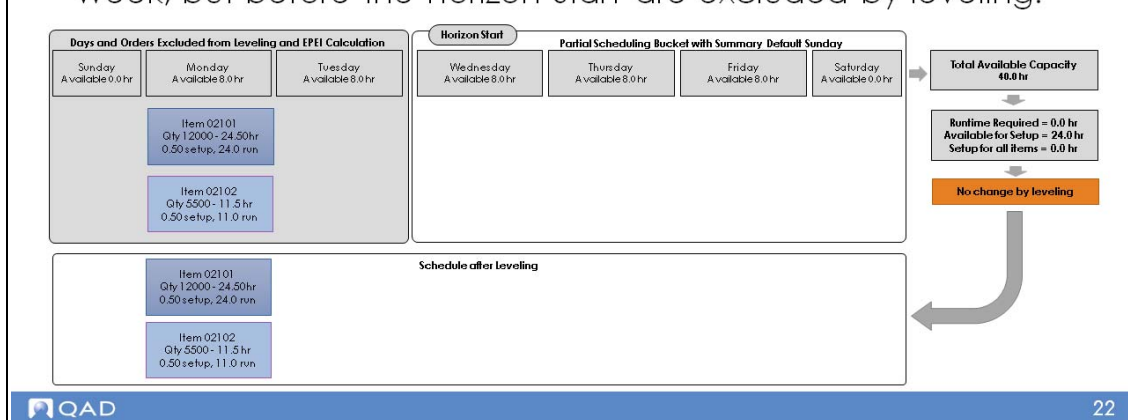
A partial bucket with fewer days can appear at the beginning and/or end of a scheduling horizon. This happens when either the Horizon Start day of the week does not match the value for the Summary Default day of the week defined in MRP Control, or the Horizon End day does not match the day prior to the Summary Default day of the week defined in MRP Control.

In this example, the value for the Summary Default day is Sunday. The horizon begins with a partial week consisting of four days (Tuesday to Friday) and ends with a partial week consisting of three days (Tuesday to Thursday), with Monday being an exceptional non-working day.

Partial Bucket with Excluded Capacity and Production

Partial Bucket with Excluded Capacity and Production

- Capacity and production orders that fall within the same week, but before the Horizon Start are excluded by leveling.

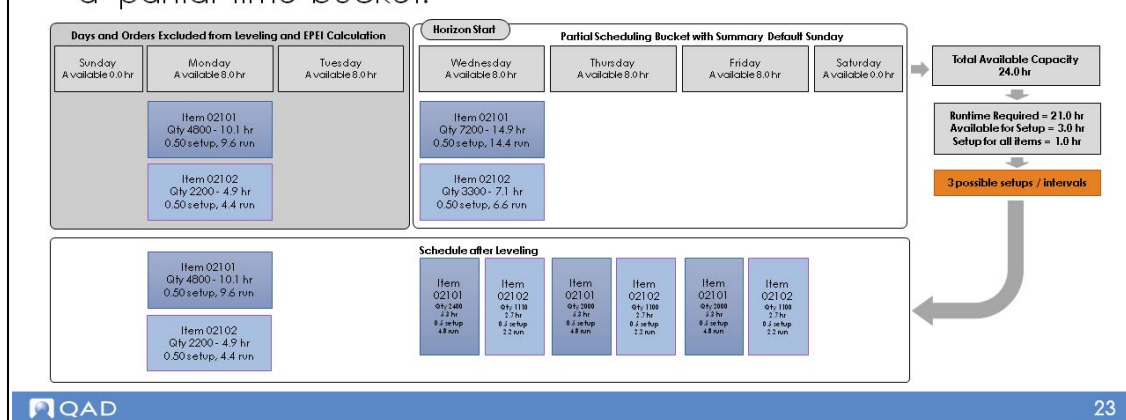


Orders scheduled at the beginning of the week are not leveled when Horizon Start falls later in the week.

Partial Bucket with Included Capacity and Production

Partial Bucket with Included Capacity and Production

- Leveling is limited to the capacity and production orders within a partial time bucket.



Orders scheduled at the beginning and middle of the week are leveled differently when Horizon Start falls after the Summary Default day in the week.

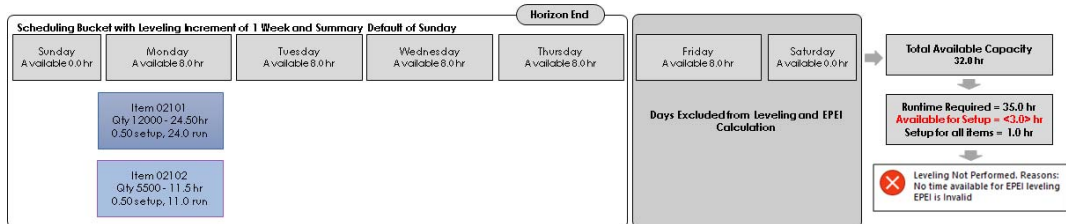
Leveling is performed based on the capacity and production within the short time bucket.

Capacity and production orders that fall within the same week but before the partial are processed ahead of Horizon Start.

Partial Bucket with Insufficient Capacity for Leveling

Partial Bucket with Insufficient Capacity for Leveling

- Capacity and production orders that fall within the same week, but after the Horizon End are excluded by leveling.
- A partial time bucket may prevent leveling because of the reduced capacity.



Capacity and production orders that fall within the same week, but after the Horizon End, are excluded by leveling. The figure above shows how orders scheduled at the beginning of the week cannot be scheduled. Horizon End falls in such a way as to reduce the capacity for the week.

Chapter 4

MSW Leveling Details

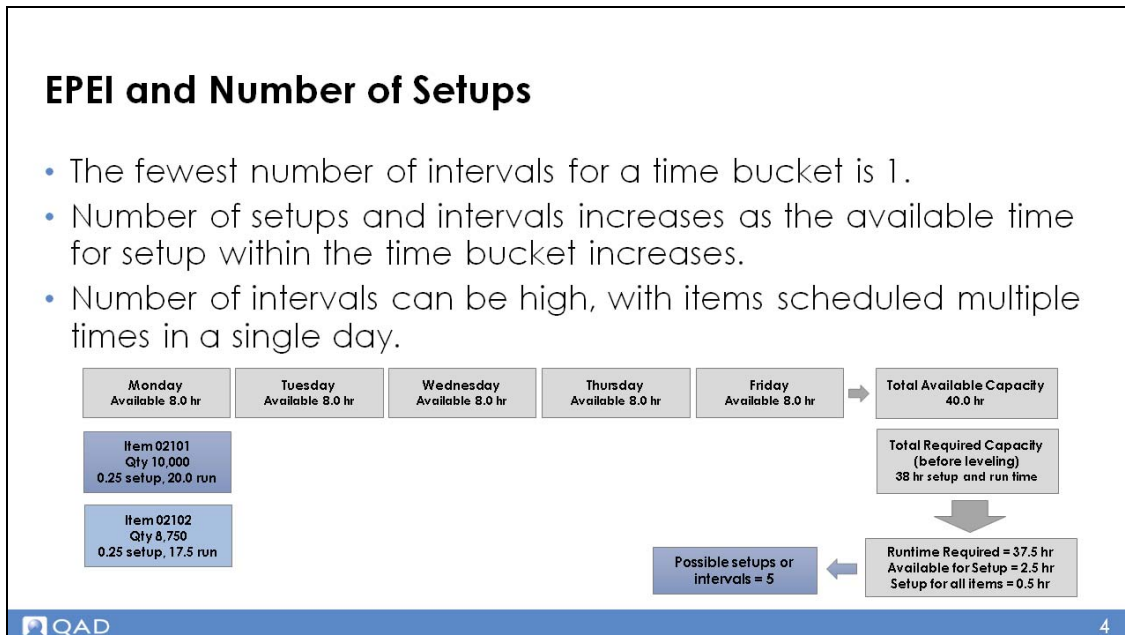
Lesson Overview

Objectives

- Identify the relationships between the calculation of EPEI, the time available for setup, number of setups, and minimum interval.
- Describe the relationship between capacity, required capacity, setup time, excess capacity, and scheduling.
- Describe the impact of greater or lesser amounts of excess capacity and scheduling.

Relationships Between the EPEI and Setup Time

EPEI and Number of Setups



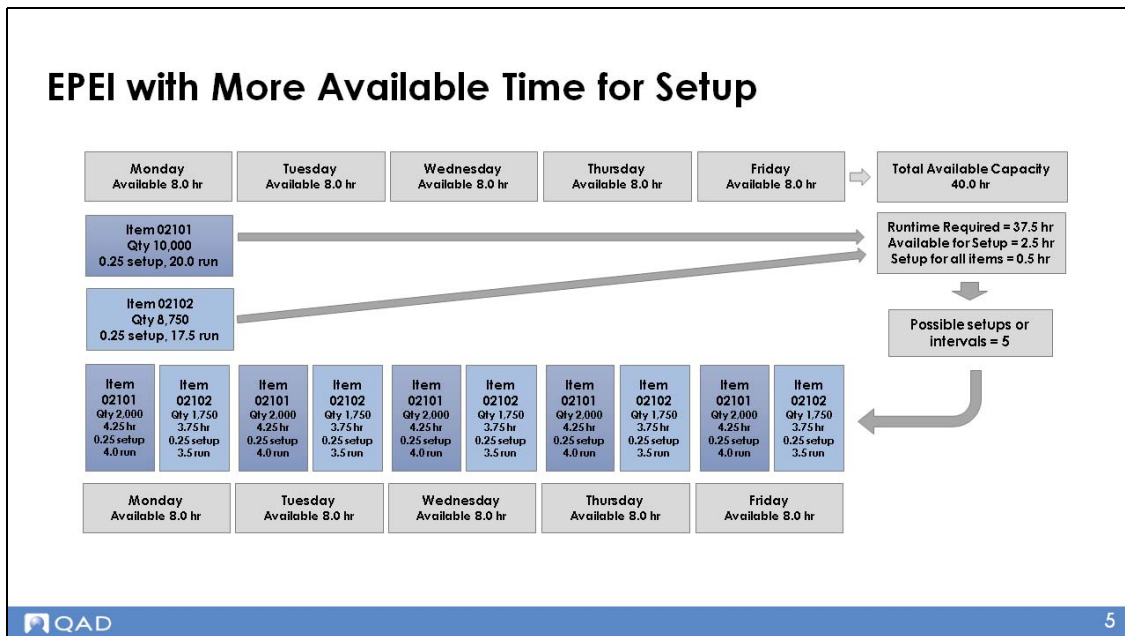
Leveling determines the number of EPE intervals for a time bucket. The number of setups and intervals increases as the available time for setup within the time bucket increases, as a factor of the required runtime. As the required runtime for the time bucket decreases, the available time for setup and the number of setups and intervals increase.

- The fewest number of intervals for a time bucket is 1, with each item being set up and produced a single time within a time bucket.
- The maximum number of intervals within an interval can be high, with items scheduled multiple times in a single day.

When the EPEI or minimum number of intervals is 1.0, then each part is produced 1 time within the time bucket.

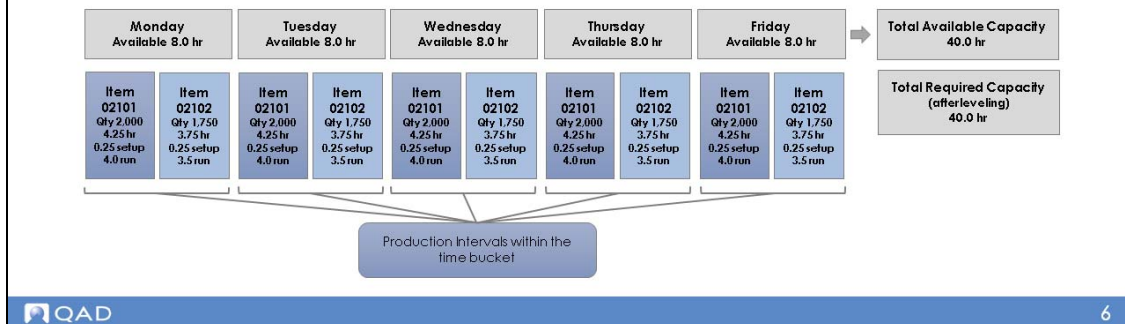
If the EPEI or minimum number of intervals is 0.2, then each part is produced 5 times within a time bucket.

EPEI with More Available Time for Setup



EPEI with More Available Time for Setup

- EPEI = 0.2 weeks resulting in five intervals for the one week time bucket.
- Scheduled production does not exceed maximum capacity of 8.0 hr per day.



EPEI = 0.2 weeks resulting in five intervals for the one-week time bucket.

Scheduled production does not exceed maximum capacity of 8.0 hr per day.

MSW Example

MSW Example Before Leveling

- The first week contains orders for 2 items scheduled on Monday.

Master Scheduling												
Capacity		02100										
Production Line	Horizon End	Record Type	Past Due	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Week 4	
02100	02/15/2019	Remaining Capacity	0	-23.4	8	8	8	8	0	0	8.6	
		Planned Capacity	0	8	8	8	8	8	0	0	40	
		Required Capacity	0	31.4	0	0	0	0	0	0	31.4	
		Scheduled Quantit	0	31000	0	0	0	0	0	0	31000	
		Cumulative Capac	0	0.6	8.6	16.6	24.6	32.6	32.6	32.6	32.6	
Schedule												
Activity	Production Lin	Item Number	Nettable 00	Past Due	01/21	01/22	01/23	01/24	01/25	01/26	01/27	01/28
Yes 02100		02101			16000							16000
Yes 02100		02102			15000							15000

MSW Example After Leveling

- Leveling schedules orders to spread the requirements over each day within the time bucket.

Master Scheduling												
Capacity		02100										
Production Line	Horizon End	Record Type	Past Due	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Week 4	
02100	02/15/2019	Remaining Capacity	0	1.4	1.4	1.4	1.4	1.4	0	0	7	
		Planned Capacity	0	8	8	8	8	8	0	0	40	
		Required Capacity	0	6.6	6.6	6.6	6.6	6.6	0	0	33	
		Scheduled Quantit	0	6200	6200	6200	6200	6200	0	0	31000	
		Cumulative Capac	0	25.4	26.8	28.2	29.6	31	31	31	31	
Schedule												
Activity	Production Lin	Item Number	Nettable 00	Past Due	01/21	01/22	01/23	01/24	01/25	01/26	01/27	01/28
Yes 02100		02101			3200	3200	3200	3200	3200			16000
Yes 02100		02102			3000	3000	3000	3000	3000			15000

Production Orders Across the Time Bucket

- Maximum daily capacity is recognized when scheduling orders.

Users.

Master Scheduling										ID									
02100										Item Number									
Capacity										Status									
Production Line										Qty To Start									
Horizon End										Release									
Record Type										Due									
Past Due																			
Monday																			
Tuesday																			
Wednesday																			
02100										02101									
02/15/2019										02102									
Remaining Capacity										02101									
Planned Capacity										02102									
Required Capacity										02101									
Scheduled Quantit										02102									
Cumulative Capac										02101									
Schedule										02102									
Activity										Item Number									
Production Line										Nettable QO									
Yes 02100										Past Due									
Yes 02100										01/21									
										01/22									
										01/23									
										01/24									
										01/25									
										01/26									
										01/27									
										01/28									
										01/29									
										01/30									
										01/31									
										02/01									
										02/02									
										02/03									
										02/04									
										02/05									
										02/06									
										02/07									
										02/08									
										02/09									
										02/10									
										02/11									
										02/12									
										02/13									
										02/14									
										02/15									
										02/16									
										02/17									
										02/18									
										02/19									
										02/20									
										02/21									
										02/22									
										02/23									
										02/24									
										02/25									
										02/26									
										02/27									
										02/28									
										02/29									
										02/30									
										03/01									
										03/02									
										03/03									
										03/04									
										03/05									
										03/06									
										03/07									
										03/08									
										03/09									
										03/10									
										03/11									
										03/12									
										03/13									
										03/14									
										03/15									
										03/16									
										03/17									
										03/18									
										03/19									
										03/20									
										03/21									
										03/22									
										03/23									
										03/24									
										03/25									
										03/26									
										03/27									
										03/28									
										03/29									
										03/30									
										03/31									
										04/01									
										04/02									
										04/03									
										04/04									
										04/05									
										04/06									
										04/07									
										04/08									
										04/09									
										04/10									
										04/11									
										04/12									
										04/13									
										04/14									
										04/15									
										04/16									
										04/17									
										04/18									
										04/19									
										04/20									
										04/21									
										04/22									
										04/23									
										04/24									
										04/25									
										04/26									
										04/27									
										04/28									
										04/29									
										04/30									
										05/01									
										05/02									
										05/03									
										05/04									
										05/05									
										05/06									
										05/07									
										05/08									
										05/09									
										05/10									
										05/11									
										05/12									
										05/13									
										05/14									
										05/15									
										05/16									
										05/17									
										05/18									
										05/19									
										05/20									
										05/21									
										05/22									
										05/23									
										05/24									
										05/25									
										05/26									
										05/27									
										05/28									
										05/29									
										05/30									
										05/31									
										06/01									
										06/02									
										06/03									
										06/04									
										06/05									
										06/06									
										06/07									
										06/08									
										06/09									
										06/10									
										06/11									
										06/12									
										06/13									
										06/14									
										06/15									
										06/16									
										06/17									
										06/18									
										06/19									
										06/20									
										06/21									
										06/22									
										06/23									
										06/24									
										06/25									
										06/26									
										06/27									
										06/28									
										06/29									
										06/30									
										07/01									
										07/02									
										07/03									
										07/04									
										07/05									
										07/06									
										07/07									
										07/08									
										07/09									
										07/10									
										07/11									
										07/12									
										07/13									
										07/14									
										07/15									
										07/16									
										07/17									
										07/18									
										07/19									
										07/20									
										07/21									
										07/22									
										07/23									
										07/24									
										07/25									
										07/26									
										07/27									
										07/28									
										07/29									
										07/30									
										07/31									
										08/01									
										08/02									
										08/03									
										08/04									
										08/05									
										08/06									
										08/07									
										08/08									
										08/09									
										08/10									
										08/11									
										08/12									
										08/13									
										08/14									
										08/15									
										08/16									
										08/17									
										08/18									
										08/19									
										08/20									
										08/21									
										08/22									
										08/23									
										08/24									
										08/25									
										08/26									
										08/27									
										08/28									
										08/29									
										08/30									
										08/31									
										09/01									
										09/02									
										09/03									
										09/04									
										09/05									
										09/06									
										09/07									
										09/08									
										09/09									
										09/10									
										09/11									
										09/12									
										09/13									
										09/14									
										09/15									
										09/16									
										09/17									
										09/18									
										09/19									
										09/20									
										09/21									
										09/22									
										09/23									
										09/24									
										09/25									
										09/26									
										09/27									
										09/28									
										09/29									
										09/30									
										10/01									
										10/02									
										10/03									
										10/04									
										10/05									
										10/06									
										10/07									
										10/08									
										10/09									
										10/10									
										10/11									
										10/12									
										10/13									
										10/14									
										10/15									
										10/16									
										10/17									
										10/18									
										10/19									
										10/20									
										10/21									
										10/22									
										10/23									
										10/24									
										10/25									
										10/26									
										10/27									
										10/28									
										10/29									
										10/30									
										10/31									
										11/01									
										11/02									
										11/03									
										11/04									
										11/05									
										11/06									
										11/07									
										11/08									
										11/09									
										11/10									
										11/11									
										11/12									
										11/13									
										11/14									
										11/15									
										11/16									
										11/17									
										11/18									
										11/19									
										11/20									
										11/21									
										11/22									
										11/23									
										11/24									
										11/25									
										11/26									
										11/27									
										11/28									
										11/29									
										11/30									
										12/01									
										12/02									
										12/03									
										12/04									
										12/05									
										12/06									
										12/07									
										12/08									
										12/09									
										12/10									
										12/11									
										12/12									
										12/13									
										12/14									
										12/15									
										12/16									
										12/17									
										12/18									
										12/19									
										12/20									
										12/21									
										12/22									
										12/23									
										12/24									
										12/25									
										12/26									
										12/27									
										12/28									
										12/29									
										12/30									
										12/31									

More Leveling Examples

Example: EPEI Leveling with 2 hours Available Capacity for Setup

Example with 2 hours Available Capacity for Setup

- Production quantities are higher, therefore the required capacity is only slight lower than production capacity.
 - Total time to setup all items for a single interval = 0.5 hour.
 - Planned capacity 40 hours
 - Required capacity for run time 38 hours
 - **Time available for setup 2 hours with 4 intervals for time bucket.**

Capacity										
Production Line	Horizon End	Record Type	Past Due	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
02100	02/16/2019	Remaining Capacity	0	30.5	8	8	8	8	0	0
		Planned Capacity	0	8	8	8	8	8	0	0
		Required Capacity	0	38.5	0	0	0	0	0	0
		Scheduled Quantity	0	38000	0	0	0	0	0	0
		Cumulative Capacity	0	14.5	-6.5	1.5	9.5	17.5	17.5	17.5
Week 4										
				1.5						

Schedule										
Activity	Production Line	Item Number	Nettable QTY	Past Due	01/21	01/22	01/23	01/24	01/25	01/26
Yes	02100	02101			16000					
Yes	02100	02102			20000					
										01/27
										18000
										20000

QAD

11

In this example production quantities are higher, therefore the required capacity is only slightly lower than production capacity.

- Planned capacity: 40 hours
- Required capacity for run time: 38 hours
- Total time to set up all items for a single interval 0.5 hours
- Time available for setup 2 hours resulting in 4 intervals in the time bucket

Lower Excess Capacity – Higher EPEI / Fewer Intervals

- **4 intervals when 2 hrs for setup.**
 - **EPEI for week = 0.25 = 1 week / 4 intervals.**
 - 12 orders for the week.
 - Average 1.2 orders for each item per day (with maximum daily capacity).

Capacity					D						
Production Line	Horizon End	Record Type	Past Due	Today	Item Number	Status	Qty To Start	Release	Due	Production Order	
02100	02/16/2019	Remaining Capacity	0	-0.1	2637232	02101	F	4,500	01/21/2019	01/21/2019	143173
		Planned Capacity	0	8	2637233	02102	F	3,100	01/21/2019	01/21/2019	143174
		Required Capacity	0	8.1	2637234	02102	F	1,900	01/22/2019	01/22/2019	143175
		Scheduled Quantit	0	7600	2637235	02101	F	4,500	01/22/2019	01/22/2019	143176
		Cumulative Capac	0	15.9	2637236	02102	F	1,200	01/22/2019	01/22/2019	143177
					2637237	02102	F	3,800	01/23/2019	01/23/2019	143178
					2637238	02101	F	3,800	01/23/2019	01/23/2019	143179
					2637239	02101	F	700	01/24/2019	01/24/2019	143180
					2637240	02102	F	5,000	01/24/2019	01/24/2019	143181
					2637241	02101	F	1,900	01/24/2019	01/24/2019	143182
					2637242	02101	F	2,600	01/25/2019	01/25/2019	143183
					2637243	02102	F	5,000	01/25/2019	01/25/2019	143184
					2495938	02101	P	18,000	01/24/2019	01/28/2019	10230014

QAD

12

This example illustrates how little excess capacity can result in higher EPEI, fewer intervals, and fewer orders. The calculated EPEI for week is 0.25, which results in 4 intervals for a one-week bucket and 12 orders for the week (not exceeding the maximum daily capacity).

The interval segments for items sequenced scheduled across the week, organized by day. With an interval that spans more than one day, production for an item can be split into multiple production orders.

Example: EPEI Leveling with 10 Hours Available Capacity for Setup

Example with 10 hours Available Capacity for Setup

- Production quantities are lower, therefore the required capacity is significantly lower than production capacity.
 - Total time to setup all items for a single interval = 0.5 hour.
 - Planned capacity 40 hours
 - Required capacity for run time 30 hours
 - **Time available for setup 10 hours with 20 intervals for time bucket.**

Capacity		Production Line	Horizon End	Record Type	Past Due	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Week 4
		02100	02/16/2019	Remaining Capac	0	22.1	8	8	8	8	0	0	9.9
				Planned Capacity	0	8	8	8	8	8	0	0	40
				Required Capacity	0	30.1	0	0	0	0	0	0	30.1
				Scheduled Quantit	0	29600	0	0	0	0	0	0	29600
				Cumulative Capac	0	-6.1	1.9	9.9	17.9	25.9	25.9	25.9	25.9

Schedule		Activity	Production Lin	Item Number	Nettable QD	Past Due	01/21	01/22	01/23	01/24	01/25	01/26	01/27	01/28
		Yes	02100	02101			15000							15000
		Yes	02100	02102			14600							14600

In this example, production quantities are lower; therefore, the required capacity is significantly lower than production capacity.

- Planned capacity: 40 hours
- Required capacity for run time: 30 hours
- Total time to set up all items for a single interval: 0.5 hours
- Time available for setup 10 hours resulting in 20 intervals in a time bucket

Greater Excess Capacity – Lower EPEI, More Orders

- 20 intervals when 10 hours for setup.

- EPEI for week 0.05 = 1 week / 20 intervals.
- 46 orders for the week.
- Average 4.6 orders for each item per day (with maximum daily capacity)

Capacity	Production Line	Horizon End	Record Type	Past Due	Monday	Tuesday	Wednesday
	02100	02/16/2019	Remaining Capacity	0	-0.2	0.1	0.1
			Planned Capacity	0	8	8	8
			Required Capacity	0	8.2	7.9	7.9
			Scheduled Quantit	0	5920	5920	5920
			Cumulative Capac	0	15.8	15.9	16

Schedule	Activity	Production Lin	Item Number	Nettable QD	Past Due	01/21	01/22	01/23
Yes	02100	02101				3112	3112	3112
Yes	02100	02102				2807	2807	2807

ID	Item Number	Status	Qty To Start	Release	Due	Production Order
2637178	02101	F	722	01/21/2019	01/21/2019	143127
2637179	02102	F	702	01/21/2019	01/21/2019	143128
2637180	02101	F	721	01/21/2019	01/21/2019	143129
2637181	02102	F	702	01/21/2019	01/21/2019	143130
2637182	02101	F	721	01/21/2019	01/21/2019	143131
2637183	02102	F	702	01/21/2019	01/21/2019	143132
2637184	02101	F	721	01/21/2019	01/21/2019	143133
2637185	02102	F	702	01/21/2019	01/21/2019	143134
2637186	02101	F	227	01/21/2019	01/21/2019	143135
2637187	02101	F	494	01/22/2019	01/22/2019	143136
2637188	02102	F	702	01/22/2019	01/22/2019	143137
2637189	02101	F	721	01/22/2019	01/22/2019	143138
2637190	02102	F	702	01/22/2019	01/22/2019	143139
2637191	02101	F	722	01/22/2019	01/22/2019	143140
2637192	02102	F	702	01/22/2019	01/22/2019	143141
2637193	02101	F	721	01/22/2019	01/22/2019	143142
2637194	02102	F	702	01/22/2019	01/22/2019	143143
2637195	02101	F	454	01/22/2019	01/22/2019	143144
2637196	02101	F	267	01/23/2019	01/23/2019	143145
2637197	02102	F	702	01/23/2019	01/23/2019	143146
2637198	02101	F	721	01/23/2019	01/23/2019	143147
2637199	02102	F	702	01/23/2019	01/23/2019	143148
2637200	02101	F	721	01/23/2019	01/23/2019	143149

This example illustrates how greater capacity results in a lower EPEI, more intervals, and a higher number of orders. The calculated EPEI for week is 0.05, which results in 20 intervals for a one-week bucket and 46 orders for the week (not exceeding maximum daily capacity).

The interval segments for items sequenced scheduled across the week, organized by day. With an interval that spans more than one day, production for an item can be split into multiple production orders.

Leveling Intervals: Calculated EPEI and Minimum Interval Parameter

Leveling with EPEI

Leveling with EPEI

- EPEI can result in multiple orders for an item for each day.

Production Line	Horizon End	Record Type	Past Due	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Week 37
02100	09/07/2019	Remaining Capacity	0	0	0	0	0	0	0	0	0
		Planned Capacity	0	8	8	8	8	8	8	0	48
		Required Capacity	0	8.3	7.3	7.8	8.3	7.3	8.3	0	47.5
		Scheduled Quantit	0	5833	5833	5833	5833	5833	5835	0	35000
		Cumulative Capacac	0	23.7	24.3	24.5	24.2	24.8	24.5	24.5	24.5

in	Item Number	Days On Han	Nettable QO	Past Due	09/08	09/09	09/10	09/11	09/12	09/13	09/14	09/08 -
	02101	0			2500	1250	1250	2500	1250	1250		10000
	02102	0			2083	3333	2084	2082	3333	2085		15000
	02103	0			1250	1250	2499	1251	1250	2500		10000

ID	Item Number	Status	Qty To Start	Release	Due	Component Status	Production Order
2884424	02101	F	1,250	09/08/2019	09/08/2019	No Status	84805
2884427	02101	F	1,250	09/08/2019	09/08/2019	No Status	84808
2884431	02101	F	1,250	09/09/2019	09/09/2019	No Status	84812
2884435	02101	F	1,250	09/10/2019	09/10/2019	No Status	84816
2884439	02101	F	1,250	09/11/2019	09/11/2019	No Status	84820
2884442	02101	F	1,250	09/11/2019	09/11/2019	No Status	84823
2884446	02101	F	1,250	09/12/2019	09/12/2019	No Status	84827
2884450	02101	F	1,250	09/13/2019	09/13/2019	No Status	84831

QAD

16

EPEI (every part every interval) is the smallest production interval possible when leveling within a time bucket.

- The interval during which every item can be setup and produced.
- Calculated from the time available for production, the setup time for each item, and the run time for each item.

The ultimate goal is to get to the shortest possible interval for producing an item while meeting demand.

Leveling with EPEI:

- Maximizes the number of intervals that every item can be produced within a time bucket, by consuming the available capacity.
- Minimizes the interval for producing each order.
- Results in greater number of orders, reducing lot sizes, and increasing the number of setups to fully use the available capacity.

Consequence:

- Production orders may have an order quantity of 1.
- It is possible to have tens or hundreds of orders for every item each day.
- Scheduling when not using Kanban can become very difficult.

Minimum Interval Parameter for Production Line

Minimum Interval Parameter for Production Line

- Minimum interval parameter to
 - Control how frequently items are produced within a time bucket when leveling.
 - Reduce the number of orders that are created by leveling.
- Production Line Maintenance
 - Set Minimum Interval in hours to determine the smallest production interval for leveling every item.
 - Example:
 - When set to 16 hours when the calendar consists of 8 hour work days, it limits the production to one interval for every two workday, or three intervals per week.

QAD

17

Maintain the Minimum Interval parameter in Production Line Maintenance (16.1.1) and Item Production Line Maintenance (16.1.4). Use the Minimum Interval parameter to:

- Control how frequently items are produced within a time bucket when leveling production, thereby reducing the number of orders that are created by leveling.
- Prevent leveling from creating more production orders for items within a time bucket than is manageable, particularly when the available capacity within a time bucket might be high.

The minimum interval:

- Is the shortest number of hours for producing an item.
- Determines the frequency which an item is produced.

The minimum interval can be set to a period of time such as a shift, a day, or week. Setting the minimum interval to the number of hours for a workday, prevents leveling from creating more than one order for an item for a day, when the calculated EPEI would otherwise result in multiple orders for a day or shift.

The leveling process uses the:

- Minimum interval instead of EPEI for scheduling items within a time bucket when the calculated EPEI is less than the minimum interval.
- Greater of the minimum interval set for the item and production line, the production line, and the calculated EPEI.
- Calculated EPEI when minimum interval is set to 0.

Minimum Interval for Production Line Example

Minimum Interval for Production Line Example

- Production Line setup with Minimum Interval to 16 hours
- Calendar for a 48 hour week.
- Leveling results in 3 intervals for a one week bucket.

Production Line	Horizon End	Record Type	Past Due	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Week 37
02100	09/07/2019	Remaining Capacity	0	0	0	0	0	0	0	0
		Planned Capacity	0	8	8	8	8	8	0	48
		Required Capacity	0	6.8	6.3	6.8	6.3	6.8	0	40
		Scheduled Quantity	0	5833	5833	5833	5833	5835	0	35000
		Cumulative Capacity	0	25.2	26.8	28	29.7	30.8	32	32

Item Number	Days On Hand	Nettable QO	Past Due	09/08	09/09	09/10	09/11	09/12	09/13	09/14	09/08
02101	0			3334		3333		3332			10000
02102	0			2499	2501	2498	2502	2498	2502		15000
02103	0				3332		2	3331		3333	10000

As a general rule, set Minimum Interval for a production line, rather than setting it for items on a production line.

- Set Minimum Interval in hours to determine the smallest production interval for leveling every item.
- When the value for minimum interval is 0, the smallest production interval is determined by the EPEI calculation.

In this example, the production line is set up with the goal of limiting production to 3 intervals per week. This is done by setting the Minimum Interval to 16 hours for a 48-hour work week.

There are multiple orders for an item within an interval when production spans more than one day. When this happens, setup appears on only the first order for the item within an interval.

Minimum Interval Parameter for an Item

Minimum Interval Parameter for an Item

- Item Production Line Maintenance
 - Set Minimum Interval in hours to determine the smallest production interval for a particular item.
 - Use when the interval for the item is different than for the production line.

Item Number: 02101
 Site: 10-201
 Production Line: 02100
 Units/Hour: 1,000.00
 Setup (D H:M:S): 0 00:30:00
 Start: 10/22/2018

Items

Units/Hour: 1,000.00
 Number of Lines: 1.0
 Setup Time (D H:M:S): 0 00:00:00
 Minimum Interval: 24.000000000 Hours
 Setup Crew: Size: 0
 Run Crew: Size: 1
 Routing: V-001
 BOM Code:
 Tool ID:
 Run Sequence 1: 2:
 Comments:

Valve Assembly

As a rule, set Minimum Interval for an item only when there is an exception for that item.

- Set Minimum Interval in hours to determine the smallest production interval for a particular item.
- Use this function when the minimum interval is not determined by either the minimum interval set for the production line or the EPEI calculation.

Minimum Interval Parameter for Item Example

Minimum Interval Parameter for Item Example

- Minimum Interval for item 02101 set to 24 hours
- Calendar for a 48 hour week.
- Leveling results in 2 intervals for a one week bucket.

Production Line	Horizon End	Record Type	Past Due	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Week 37
02100	09/07/2019	Remaining Capacity	0	0	0	0	0	0	0	0	0
		Planned Capacity	0	8	8	8	8	8	8	0	48
		Required Capacity	0	6.8	5.2	5.7	6.8	7.8	12.2	0	44.5
		Scheduled Quantity	0	5833	4167	4166	5833	5833	9168	0	35000
		Cumulative Capacity	0	25.2	28	30.3	31.5	31.7	27.5	27.5	27.5

Item Number	Days On Hand	Nettable QO	Past Due	09/08	09/09	09/10	09/11	09/12	09/13	09/14	09/08 -
02101	0			5000			5000				10000
02102	0			833	2917	1875	624	3333	5418		15000
02103	0			1250	2291	209	2500	3750			10000

In this example, item 02101 on production line 02100 is set up with the goal of limiting production to 2 intervals per week. This is done by:

- 1 Setting the minimum interval for the production line to 0 to use EPEI to determine the interval for the production line.
- 2 Setting the minimum interval for item 02101 to 24 hours for a 48-hour work week.

Chapter 5

Leveling Setup

Lesson Overview

Objectives

- Identify the elements for setting up items and production lines.
- Identify the elements for setting up items, production lines, and a Kanban process.

Setting Up to Calculate the EPEI and Leveling

Required and Optional Setup

Required and Optional Setup

- Required Setup
 - Set up production line and items with setup times and run rates.
- Additional Optional Setup
 - Setup production line and items and also setup a Kanban process and items.

Item Number: 02101
 Site: 10-201
 Production Line: 02100
 Units/Hour: 1,000.00
 Setup (D H:M:S): 0 00:30:00
 Start: 10/22/2018

Items

Units/Hour:
 Number of Lines:
 Setup Time (D H:M:S):
 Minimum Interval: Hours

Site: 10-201 Lean Manufacturing Site
 Process: FA Final Assembly

Item Number	Step	UM	UM Conv	Kanban Qty	UM Site	Superskit
02102	0	EA	1.0000	100.0	10-201	FGI
02103	0	EA	1.0000	100.0	10-201	FGI
02104	0	EA	1.0000	100.0	10-201	FGI

Item: 02102 Step: 0 Mfg Seq #:

EPEI: Setup Time (D H:M:S):

EPEI Auto: ☒ Cycle Time (D H:M:S):

Min EPEI: Work Time (D H:M:S):

Yield: Lead Time (D H:M:S):

Start Op: End Op: Move Time (D H:M:S):

Req Oper: Equipment Time (D H:M:S):

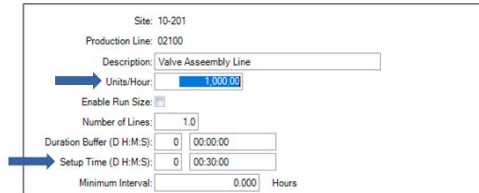
Note For a production line, all items must be set up:

- 1 For the production line alone, with setup time and run rate or,
- 2 For the production line together with a Kanban process, with setup time and cycle time.

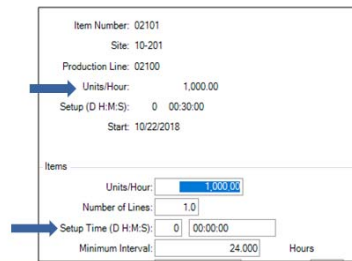
Required Setup for Production Lines and Items

Required Setup for Production Lines and Items

- Production line with:
 - Setup time.
 - Run rate (Units/Hour).
 - Minimum Interval (optional)
- Item and production line.
 - Setup time when different than for the production line itself.
 - Run Rate when different than for the production line itself.
 - Minimum Interval (optional)



Site: 10-201
Production Line: 02100
Description: Valve Assembly Line
Units/Hour: 1,000.00
Enable Run Size: ☐
Number of Lines: 1.0
Duration Buffer (D H:M:S): 0 00:00:00
Setup Time (D H:M:S): 0 00:30:00
Minimum Interval: 0.000 Hours



Item Number: 02101
Site: 10-201
Production Line: 02100
Units/Hour: 1,000.00
Setup (D H:M:S): 0 00:30:00
Start: 10/22/2018
Items
Units/Hour: 1,000.00
Number of Lines: 1.0
Setup Time (D H:M:S): 0 00:00:00
Minimum Interval: 24.000 Hours

QAD

5

The required setup includes:

- Production lines with production rate (units/hour) and setup time.
- Items and production lines with production rates and setup times when they are different than defined for the production line itself.
- Production line calendar.

These are needed for the proper calculation of required capacity from the setup time and run rate for items and the production line (including items for a Kanban process). The required capacity appears in the MSW Capacity panel.

Setup Option of a Kanban Process and Items

Setup Option of a Kanban Process and Items

- Not appropriate for push production items, that are not replenished using Kanban or pull replenishment.
- Pros:
 - Minimum EPEI is an alternative to Minimum Interval for production line.
 - Leveling interval is the larger of Minimum EPEI or the calculated EPEI.
 - Fixed EPEI can be used instead of the calculated EPEI or Minimum EPEI when EPEI Auto is not selected.
- Cons:
 - Requires implementation of Kanban.



6

The setup of a Kanban process and items is optional and is not appropriate for push production items, which are not replenished using Kanban or pull replenishment. It has both pros and cons.

Pros:

- Minimum EPEI for an item and Kanban process is an alternative to the Minimum Interval for a production line.
- The leveling interval is determined by the larger of Minimum EPEI or calculated EPEI when EPEI Auto is Yes.
- Fixed EPEI is used instead of the calculated EPEI or Minimum EPEI when EPEI is not selected (set to No).

Cons:

- Requires implementation of Kanban.

Setup Option for Kanban Process

Setup Option for Kanban Process

- Enter the Production Line for the process, after setting up the production line and items.
- Uptime% and number of Resources determine total available time.
- EPEI Display Options determines how the value for Min EPEI appears for items and the Kanban process.

QAD

7

Set up the production line and items, together with a Kanban process and item.

- Enter the Production Line for the process, after setting up the production line and items.
- Uptime% and number of Resources determine total available time.
- EPEI Display Option determines how the value for Min EPEI is to be displayed for items and the Kanban process. If you set EPEI Auto to No and enter a value in the EPEI field in the Kanban Process Detail frame, the entered EPEI indicates the EPEI interval and is expressed in the unit selected for EPEI Display Option (Days, Weeks, Months, and so on). The system then uses this value together with the available time and calendar setup to calculate the number of changeovers in a leveling bucket.

Note There is no look-up browse or validation for Production Line.

Setup Option for Kanban Process Items

Setup Option for Kanban Process Items

- The cycle time is used as run time together with setup time to determine the time required for production.

The screenshot shows the 'Kanban Process Maintenance' screen for Item 02101. The 'EPEI' field is set to 0.861. The 'EPEI Auto' checkbox is checked. The 'Min EPEI' field is set to 0.000. The 'Yield' is set to 100.00%. The 'Start Op' is 0 and 'End Op' is 10. The 'Req Oper' is 0.0. The 'Step' is 0. The 'Mfg Seq #' is 1. The 'Setup Time (D H:M:S)' is 00:12:00. The 'Cycle Time (D H:M:S)' is 00:00:01.8000. The 'Work Time (D H:M:S)' is 00:00:07.1006. The 'Lead Time (D H:M:S)' is 00:00:00. The 'Move Time (D H:M:S)' is 00:00:00. The 'Equipment Time (D H:M:S)' is 00:00:00.

- Leveling recognizes the value for Min EPEI when calculating the EPEI.
 - Min EPEI is expressed for the unit selected for EPEI Display Option for the Kanban process.



8

You can use Kanban Process Maintenance (17.1.3.1) to set up Kanban process items:

- The cycle time is used as run time to, together with setup time, determine the time required for production.
- EPEI is not used when EPEI Auto is selected.
- Leveling recognizes the value for Min EPEI when calculating EPEI.
- Min EPEI can be set to 0.000 or the value specified in EPEI Display Option (Days, Weeks, Months, and so on).
- Min EPEI is expressed in the unit selected for EPEI Display Option in the Kanban process.



Kanban Process Item and Minimum EPEI

Kanban Process Item and Minimum EPEI

- Set the Minimum EPEI for a Kanban process to limit the number of orders.
- The EPEI time bucket is determined by the EPEI Display Option for the Kanban Process.

The screenshot displays the QAD software interface for setting Kanban process parameters. The main window is titled 'Lean Manufacturing Site' and shows various settings for a Kanban process. Key fields include:

- Site:** 10-201
- Process:** FA
- Available Time (H:M:S):** 08:00:00
- Uptime:** 100.00%
- Process Function:** PACE
- Production Line:** 02100-FA
- Process Planner ID:** DRB
- Level Mix Sequence:** info_seq
- Takt Time Calculation:** EPEICalc
- Lead Time Method:** Variable
- EPEI Display Option:** Days
- Minimum Process EPEI:** 0.000
- Pitch Quantity:** 0.000
- Pitch Interval (D H:M:S):** 0 00 00
- Item:** 02101
- EPEI:** 0.861
- EPEI Auto:** ☒ (checked)
- Min EPEI:** 0.000
- Yield:** 100.00%
- Start Op:** 0
- End Op:** 10
- Req Oper:** 0.0
- Setup Time (D H:M:S):** 0 00:12:00
- Cycle Time (D H:M:S):** 0 00 00 01.8000
- Work Time (D H:M:S):** 0 00 00 07.1006
- Lead Time (D H:M:S):** 0 00:00:00
- Move Time (D H:M:S):** 0 00:00:00
- Equipment Time (D H:M:S):** 0 00:00:00

The QAD logo is visible in the bottom left corner, and the page number '9' is in the bottom right corner.

Setting the minimum EPEI can limit the size of the EPEI used for scheduling, thereby limiting the number of orders scheduled within an interval. The minimum EPEI can be set up for items that are defined for a Kanban process and production line. The EPEI time bucket is determined by the EPEI Display Option for the Kanban process.

The setting for the EPEI Display Option parameter determines how the value for Min EPEI is to be displayed for items and the Kanban process. EPEI is not used when EPEI Auto is selected. Set Min EPEI to a value in the unit selected for EPEI Display Option (Days, Weeks, Months).

Note The minimum EPEI cannot be configured for items and production lines that are not defined for a Kanban process.

Minimum Interval is applied to non-Kanban items during leveling.

You can define the minimum interval for a production line using Production Line Maintenance. You can also define a specific minimum interval for each item on the production line using Item Production Line Maintenance.

Required Calendars and Calendar Exceptions

Required Calendars and Calendar Exceptions

- Create calendars for the production line.
 - The system considers holidays, overtime, and downtime.
 - Holidays reduce available time; overtime increases available time; and shift adjustments, like downtime, reduce available time.

Site: 10-201
Production Line: 02100

Shift:

	Hours	Start Time	Productivity
Sunday	0.00	00:00	100.00%
Monday	8.00	08:00	100.00%
Tuesday	8.00	08:00	100.00%
Wednesday	8.00	08:00	100.00%
Thursday	8.00	08:00	100.00%
Friday	8.00	08:00	100.00%
Saturday	0.00	00:00	100.00%
Shift Total	40.00		
All Shifts	40.00		

Create calendars for a production line with Production Line Calendar Maint (16.1.13.1).

The system considers holidays, overtime, and downtime. Holidays reduce available time; overtime increases available time; and shift adjustments, like downtime, reduce available time.

Product Information Resources

QAD offers a number of online resources to help you get more information about using QAD products.

[QAD Forums \(community.qad.com\)](https://community.qad.com)

Ask questions and share information with other members of the user community, including QAD experts.

[QAD Knowledgebase \(knowledgebase.qad.com\)*](https://knowledgebase.qad.com)

Search for answers, tips, or solutions related to any QAD product or topic.

[QAD Document Library \(documentlibrary.qad.com\)](https://documentlibrary.qad.com)

Get browser-based access to user guides, release notes, training guides, and so on; use powerful search features to find the document you want, then read online, or download and print PDF.

[QAD Learning Center \(learning.qad.com\)*](https://learning.qad.com)

Visit QAD's one-stop destination for all courses and training materials.

*Log-in required

