

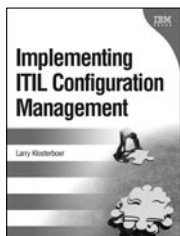
ITIL Capacity Management



Larry Klosterboer

The **ITIL** Series

Related Books of Interest



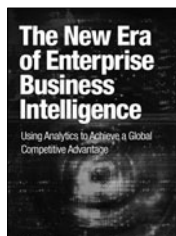
Implementing ITIL Configuration Management, 2nd Edition

By Larry Klosterboer
ISBN: 0-13-138565-8

Practical, Real-World ITIL Configuration Management—From Start to Finish

Now, there's a practical, start-to-finish guide to ITIL configuration management for every IT leader, manager, and practitioner. ITIL-certified architect and solutions provider Larry Klosterboer helps you establish a clear roadmap for success, customize standard processes to your unique needs, and avoid the pitfalls that stand in your way.

You'll learn how to plan your implementation, deploy tools and processes, administer ongoing configuration management tasks, refine ITIL information, and leverage it for competitive advantage. Throughout, Klosterboer demystifies ITIL's jargon, illuminates each technique with real-world advice and examples, and helps you focus on the specific techniques that offer maximum business value in your environment.



The New Era of Enterprise Business Intelligence, 1st Edition **Using Analytics to Achieve a Global Competitive Advantage**

By Mike Biere
ISBN: 0-13-707542-1

A Complete Blueprint for Maximizing the Value of Business Intelligence in the Enterprise

The typical enterprise recognizes the immense potential of business intelligence (BI) and its impact upon many facets within the organization—but it's not easy to transform BI's potential into real business value. In *The New Era of Enterprise Business Intelligence*, top BI expert Mike Biere presents a complete blueprint for creating winning BI strategies and infrastructure, and systematically maximizing the value of information throughout the enterprise.

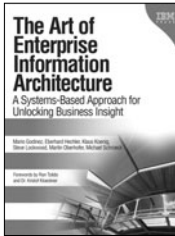
This product-independent guide brings together start-to-finish guidance and practical checklists for every senior IT executive, planner, strategist, implementer, and the actual business users themselves. Drawing on thousands of hours working with enterprise customers, Biere helps decision-makers choose from today's unprecedented spectrum of options, including the latest BI platform suites and appliances. He offers practical, "in-the-trenches" insights on a wide spectrum of planning and implementation issues, from segmenting and supporting users to working with unstructured data.



Listen to the author's podcast at:
ibmpressbooks.com/podcasts

Sign up for the monthly IBM Press newsletter at
ibmpressbooks/newsletters

Related Books of Interest



The Art of Enterprise Information Architecture **A Systems-Based Approach for Unlocking Business Insight**

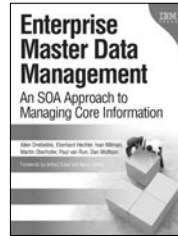
By Mario Godinez, Eberhard Hechler, Klaus Koenig, Steve Lockwood, Martin Oberhofer, and Michael Schroeck

ISBN: 0-13-703571-3

Architecture for the Intelligent Enterprise: Powerful New Ways to Maximize the Real-time Value of Information

In this book, a team of IBM's leading information management experts guide you on a journey that will take you from where you are today toward becoming an "Intelligent Enterprise."

Drawing on their extensive experience working with enterprise clients, the authors present a new, information-centric approach to architecture and powerful new models that will benefit any organization. Using these strategies and models, companies can systematically unlock the business value of information by delivering actionable, real-time information in context to enable better decision-making throughout the enterprise—from the "shop floor" to the "top floor."



Enterprise Master Data Management **An SOA Approach to Managing Core Information**

By Allen Dreibelbis, Eberhard Hechler, Ivan Milman, Martin Oberhofer, Paul Van Run, and Dan Wolfson

ISBN: 0-13-236625-8

The Only Complete Technical Primer for MDM Planners, Architects, and Implementers

Enterprise Master Data Management provides an authoritative, vendor-independent MDM technical reference for practitioners: architects, technical analysts, consultants, solution designers, and senior IT decision makers. Written by the IBM® data management innovators who are pioneering MDM, this book systematically introduces MDM's key concepts and technical themes, explains its business case, and illuminates how it interrelates with and enables SOA.

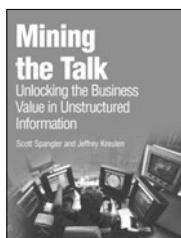
Drawing on their experience with cutting-edge projects, the authors introduce MDM patterns, blueprints, solutions, and best practices published nowhere else—everything you need to establish a consistent, manageable set of master data, and use it for competitive advantage.



Listen to the author's podcast at:
ibmpressbooks.com/podcasts

Sign up for the monthly IBM Press newsletter at
ibmpressbooks/newsletters

Related Books of Interest



Mining the Talk Unlocking the Business Value in Unstructured Information

By Scott Spangler and Jeffrey Kreulen
ISBN: 0-13-233953-6

Leverage Unstructured Data to Become
More Competitive, Responsive, and
Innovative

In *Mining the Talk*, two leading-edge IBM
researchers introduce a revolutionary
new approach to unlocking the busi-
ness value hidden in virtually any form of
unstructured data—from word processing
documents to websites, emails to instant
messages.

The authors review the business drivers
that have made unstructured data so
important—and explain why conventional
methods for working with it are inad-
equate. Then, writing for business profes-
sionals—not just data mining specialists—they walk step-by-step through exploring
your unstructured data, understanding it,
and analyzing it effectively.



Viral Data in SOA
An Enterprise Pandemic
Fishman
ISBN: 0-13-700180-0



Innovation Passport
The IBM First-of-a-Kind (FOAK)
Journey from Research to
Reality
Frederich and Andrews
ISBN: 0-13-239076-0



The Business of IT
How to Improve Service and
Lower Costs
Ryan and Raducha-Grace
ISBN: 0-13-700061-8



The Greening of IT
How Companies Can Make a
Difference for the Environment
Lamb
ISBN: 0-13-715083-0



DB2 pureXML Cookbook
Master the Power of the IBM
Hybrid Data Server
Nicola and Kumar-Chatterjee
ISBN: 0-13-815047-8

Sign up for the monthly IBM Press newsletter at
ibmpressbooks/newsletters

This page intentionally left blank

ITIL Capacity Management

This page intentionally left blank

ITIL Capacity Management

Larry Klosterboer

**IBM Press
Pearson plc**

**Upper Saddle River, NJ • Boston • Indianapolis • San Francisco
New York • Toronto • Montreal • London • Munich • Paris • Madrid
Cape Town • Sydney • Tokyo • Singapore • Mexico City**

ibmpressbooks.com

The author and publisher have taken care in the preparation of this book, but make no expressed or implied warranty of any kind and assume no responsibility for errors or omissions. No liability is assumed for incidental or consequential damages in connection with or arising out of the use of the information or programs contained herein.

© Copyright 2011 by International Business Machines Corporation. All rights reserved.

Note to U.S. Government Users: Documentation related to restricted right. Use, duplication, or disclosure is subject to restrictions set forth in GSA ADP Schedule Contract with IBM Corporation.

IBM Press Program Managers: Steven M. Stansel, Ellice Uffer

Cover Design: IBM Corporation

Associate Publisher: Dave Dusthimer

Marketing Manager: Stephane Nakib

Acquisitions Editor: Mary Beth Ray

Publicist: Heather Fox

Development Editor: Susan Brown Zahn

Technical Editors: Charles Betz, Brian Hopper

Managing Editor: Kristy Hart

Editorial Assistant: Vanessa Evans

Cover Designer: Alan Clements

Project Editor: Anne Goebel

Copy Editor: Cheri Clark

Indexer: WordWise Publishing Services, LLC

Compositor: Nonie Ratcliff

Proofreader: Linda Seifert

Manufacturing Buyer: Dan Uhrig

Published by Pearson plc

Publishing as IBM Press

IBM Press offers excellent discounts on this book when ordered in quantity for bulk purchases or special sales, which may include electronic versions and/or custom covers and content particular to your business, training goals, marketing focus, and branding interests. For more information, please contact

U. S. Corporate and Government Sales

1-800-382-3419

corpsales@pearsontechgroup.com

For sales outside the U. S., please contact

International Sales

international@pearson.com

The following terms are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both: IBM, IBM Press, WebSphere, pSeries, AIX, DB2, Rational, ClearCase, Tivoli, Lotus, Domino, z/OS, and iSeries.

IT Infrastructure Library is a registered trademark of the Central Computer and Telecommunications Agency which is now part of the Office of Government Commerce. ITIL is a registered trademark and a registered community trademark of the Office of Government Commerce, and is registered in the U.S. Patent and Trademark Office.

Microsoft, Hyper-V, Windows, and SharePoint are trademarks of Microsoft Corporation in the United States, other countries, or both.

Java and all Java-based trademarks and logos are trademarks or registered trademarks of Oracle and/or its affiliates.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.

Library of Congress Cataloging-in-Publication Data is on file.

All rights reserved. This publication is protected by copyright, and permission must be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording, or likewise. For information regarding permissions, write to:

Pearson Education, Inc.
Rights and Contracts Department
501 Boylston Street, Suite 900
Boston, MA 02116
Fax (617) 671 3447
ISBN-13: 978-0-13-706592-9
ISBN-10: 0-13-706592-2

Text printed in the United States on recycled paper at Courier in Westford, Massachusetts.
First printing February 2011

This page intentionally left blank

This book is for Brittiany.
As you continue to grow in wisdom and strength,
may you always keep your childlike joy.

This page intentionally left blank

Contents

Preface	xxi
Acknowledgments	xxv
About the Author	xxvii
Part I Concepts in Managing Capacity	1
Chapter 1 Introduction to Capacity Management	3
The ITIL Life Cycle	4
The Overall Library	4
The Service Management Life Cycle	4
The Purpose and Goals of Capacity Management	6
The Major Purpose	6
Other Purposes	7
General Goals for Capacity Management	7
Defining Specific Goals for Your Organization	8
Interfaces to and Dependencies on Other ITIL Processes	8
Capacity Management and Service Continuity	9
Capacity Management and Configuration Management	9
Capacity Management and Release Management	9
Other Interfaces	9
The Business Case for Capacity Management	10
Cost Avoidance	10
Business Agility	11
A Great Start for Financial Management	11

Important Risks to Consider	12
Missing Business Capacity Data	12
Inconsistent Component Capacity Data	12
Lack of Analysis Skill and Tools	13
Summary and Next Steps	14
Chapter 2 The Geography of Managing Capacity	15
Capacity Pools and Component Capacity Management	15
Defining Capacity Pools	16
Boundaries of Capacity Pools	16
Granularity of Capacity Pools	17
Managing Capacity Pools	19
Capacity Streams and Service Capacity Management	19
Defining Capacity Streams	19
Confluences and Shared Capacity	20
The Value of Capacity Streams	21
Managing Capacity Streams	22
How Virtualization Affects Capacity Management	22
Virtualization Creates Subpools	23
Managing Virtual Capacity Pools	23
Sharing Virtual Resource Pools Between Streams	24
Over-Subscription and Risks of Virtualization	24
Summary and Next Steps	25
Chapter 3 Understanding Capacity Demand	27
Trend-Based Forecasts	27
Component-Based Trends	27
Service-Based Trends	29
Business-Based Trends	29
Portfolio-Based Forecasts	30
Business-Driven or “Top Down” Portfolio	30
IT-Driven Portfolio	31
Innovation-Driven Portfolio	32
Business Event Forecasts	32
The Blended Capacity Forecast	33
Using the Forecast for Cost Management	35
Cost Avoidance Through Increased Utilization	35
Cost Reduction Through Decommissioning and Recovery	35
Projecting and Tracking Cost Avoidance and Cost Reduction	36
Summary and Next Steps	36
Chapter 4 Dimensions of Capacity Growth	39
Grow the Base	39
Growth by Demand	40
Growth by Refresh	40

Grow the Business	42
Project-Based Growth	42
Service-Based Growth	45
Summary and Next Steps	45

Part II Best Practices in Capacity Management 47

Chapter 5 Establish the Capacity Management Information System 49

Purpose of the Capacity Management Information System	49
Repository of Capacity Information	49
Interface to Integrated Service Management	50
Reporting and Decision Making	52
Contents of the Capacity Management Information System	52
Utilization Data	52
Capacity Data	54
Capacity Plans	56
First Steps to Implementation	57
Define Requirements	57
Select Tools	58
Gather Data	58
Implement Processes	59
Train Staff	59
Using the Capacity Management Information System	60
Forecasting Capacity Needs	60
Making Capacity Decisions	60
Integrating Service Management	60
Summary and Next Steps	61

Chapter 6 Define and Manage Capacity Plans 63

Scope of a Capacity Plan	63
Service Capacity Plans	63
Component Capacity Plans	64
How Many Plans?	65
Format of a Capacity Plan	66
The Essential Elements	66
The Right Level of Detail	69
Maintaining Capacity Plans	69
Periodic Reviews	70
Coping with Major Changes	71
Storing Capacity Plans	72
Format of the Plans	72
Maintaining Version Control	73
Summary and Next Steps	74

Chapter 7	Staff the Capacity Management Team	75
Implementation Roles		75
Capacity Process Owner		76
Capacity Management Information System Designer		77
Process Engineer		78
Project Manager		79
Operational Roles		81
Capacity Service Owner		81
Capacity Analyst		82
Capacity Data Manager		83
Capacity Planner		85
A Word About Skills		86
Skills, Roles, and Staffing		86
Developing Capacity Management Skills		87
Skill Maturity and Team Composition		87
Summary and Next Steps		88
Chapter 8	Implement the Capacity Management Process	89
The High-Level Process		89
The ITIL Process		90
Adopting and Configuring a Process		91
Attributes of a Good High-Level Process		93
Defining and Documenting Capacity Policies		94
Capacity Monitoring Policies		95
Capacity Acquisition Policies		96
Policy for Capacity Incidents and Changes		97
Policy for Capacity Planning on New Projects		98
Creating Capacity Procedures		98
Process Steps Create Procedures		98
Procedures for Capacity Reviews		99
Procedures for Improving Capacity		100
Procedures for Capacity Planning		100
Managing Capacity Process Assets		101
Document Format and Storage		101
Reviews and Process Approvals		102
Making Updates and Tracking Revisions		103
Summary and Next Steps		103
Chapter 9	Relate Capacity and Performance	105
Performance Is Capacity in a Moment		105
Definition of Performance Management		106
Time Scale for Performance Testing		106
Performance Management in the Capacity Management Process		107

Expand Capacity to Improve Performance	109
Techniques to Measure Performance	109
Techniques to Improve Performance	110
Diagnosing Performance Problems	111
Understanding Peaks and Valleys	113
Creating a Performance Profile	114
Measuring Performance Trends	116
Integrating Performance into the Capacity Plan	116
Virtualization's Impact on Performance	117
How Hypervisors Improve Performance	117
How Virtualization Automates Performance Management	117
Summary and Next Steps	118

Chapter 10 Choose Capacity Management Tools 119

Tools to Track Component Capacity	119
Specific Requirements in This Class	120
Available Tools	121
Specialized Tools Approach	122
Generalized Tools Approach	123
Tools to View Service Capacity	123
Specific Requirements in This Class	124
Available Tools	124
Build or Buy	125
Performance Management Tools	125
Specific Requirements in This Class	126
Available Tools	127
Tools for a Capacity Management Information System	128
Specific Requirements in This Class	128
Available Tools	129
How to Choose the Best Tools	129
Summary and Next Steps	131

Chapter 11 Produce Capacity Reports 133

Capacity Reports	133
Component Exception Reports	134
Component Trending Reports	135
Service Trending Reports	136
Capacity Management Reports and Process Metrics	138
Measuring Capacity Trend Accuracy	138
Tracking Capacity-Related Incidents	139
Evaluating the Completeness of Capacity Plans	140
Summary and Next Steps	141

Part III Common Issues in Capacity Management 143

Chapter 12 Business Capacity Planning 145

The Scope of Business Capacity Planning	145
Defining Business Capacity	146
How to Measure Business Capacity Utilization	147
Predicting Business Capacity Needs	149
The Challenge of Planning Business Capacity	150
Effort Versus Benefit	150
Getting Agreement on Measurements	151
The Place of Business Capacity Planning in Business Strategy	152
Integrating Business Capacity Planning with IT Capacity Planning	153
The Business Component Hierarchy	153
The Line Between IT Services and Business Processes	154
Integrated Utilization	155
Integrated Capacity Plans	155
Managing IT Capacity without Business Capacity Information	155
Summary and Next Steps	156

Chapter 13 Smoothing the Order Cycle 157

Establishing Capacity Buffers and Reorder Levels	157
Determining Capacity Buffers	157
Establishing Reorder Levels	158
First Guesses and Fine-Tuning	159
Factors Affecting Reorder Levels	159
Deployment Time	160
Process Maturity	160
Vendor Packaging	160
Virtualization Standards	161
Cost-Containment Efforts	162
Ordering the Right Amount	163
Ordering Individual Units	163
Ordering Hardware for Virtualization	163
Volume Ordering	165
Finding the Right Balance	165
Reclaiming Capacity Instead of Reordering	166
How Reclaimed Capacity Affects Capacity Demand	166
How Reuse Affects Reorder Levels	166
Creative Ways to Reuse Capacity	167
Summary and Next Steps	167

Chapter 14 Capacity Management in a Project Context	169
Capacity Plans as Project Deliverables	169
Adding Capacity Requirements in Project Definition	170
Considering Capacity and Performance in the System Architecture	171
Defining and Executing Capacity Test Cases	172
Building the Capacity Plan at Project Time	173
Testing and Estimating Capacity Utilization	173
Architecting for Capacity Growth	174
Engaging Capacity Management in the Project	175
Turning the Capacity Plan Over to Operations	177
When Capacity Management Has Been Engaged	177
When Capacity Management Was Not Engaged	178
Essentials of Operational Turnover	179
Summary and Next Steps	179
Chapter 15 Integrating Capacity Planning with IT Processes	181
Integrating with Availability Management	181
Process Linkage	182
Data Linkage	183
Benefits of Integration	183
Integrating with Configuration Management	183
Process Linkage	184
Data Linkage	184
Benefits of Integration	185
Integrating with Change Management	185
Process Linkage	186
Data Linkage	187
Benefits of Integration	187
Integrating with Incident Management	187
Process Linkage	188
Data Linkage	188
Benefits of Integration	189
Integrating with Service Continuity Management	190
Process Linkage	190
Data Linkage	191
Benefits of Integration	192
Integrating with Release and Deployment Management	192
Process Linkage	192
Benefits of Integration	193
Chapter Summary	193
Index	195

This page intentionally left blank

Preface

Every IT organization is already managing its capacity. Unfortunately, many organizations manage capacity poorly because they have not recognized the importance or value of a capacity management program. Others recognize the importance of managing capacity but lack essential knowledge and organized systems to maintain capacity information. Still other organizations manage capacity effectively in one or two areas, but need consistency and a stronger team to effectively manage all IT capacity. If you recognize yourself in any of these categories, this book is for you. You will learn the essential skills and understand the fundamental concepts that will help you to manage the IT capacity your organization uses much more effectively than you do today.

This book is much more than the opinion of one author. It is based on a set of best practices that have been consciously and conscientiously gathered over decades by literally thousands of IT organizations. Every one of those organizations struggled with the same issues that your organization struggles with. Every one of them learned lessons the hard way. But they didn't stop there! They also reached out to share those lessons they have learned and to help others understand what techniques and tools work. The British Office of Government Commerce took the time and put forth the effort to gather all of this wisdom in one place called the Information Technology Infrastructure Library® (ITIL®), and now you can benefit from it.

This book is firmly based on the concepts gathered and published in the ITIL core library. It will expand on the roughly 20 pages you'll find describing capacity management in the *ITIL Service Design* volume. This deeper coverage allows for a more remedial approach and I hope makes the book more accessible. The only assumption I'll make on your current skill level is that you're an IT person who is interested and responsible for helping your organization manage IT capacity better than it does today.

Organization of This Book

This book is organized around three separate parts serving three related purposes. Part I, “Concepts in Managing Capacity,” focuses on the core concepts of capacity management. As with any new endeavor, it is important that you understand the vocabulary and general ideas before you can effectively apply the knowledge you will gain. This first section provides the necessary background for those who are relatively new to the capacity management terms used in ITIL.

Chapter 1, “Introduction to Capacity Management,” starts at the very beginning with a bit of background on the ITIL library and the place of capacity management in the library. It helps you to understand both the pros and the cons of capacity management, and prepares you for the risks you might run into.

An extended metaphor runs throughout Chapter 2, “The Geography of Managing Capacity.” This important material describes capacity management as the stewardship of a set of pools and streams. The pools represent homogenous capacity groupings that are managed via component capacity management, and the streams represent heterogeneous IT groupings that are managed via IT service capacity management. This chapter is referenced frequently throughout the book, as these concepts are critical to the best practices found in ITIL.

Chapter 2 describes the primary objects used in capacity management, which are capacity pools and capacity streams. Chapter 3, “Understanding Capacity Demand,” demonstrates the primary action of capacity management, which is tracking capacity utilization and predicting what future utilization will look like. This is the heart of the capacity management process. The mature capacity management program will excel at the techniques described in Chapter 3.

Part I closes with some details about how capacity grows in an environment. Much of the material in Chapter 3 will seem obvious, but if you don’t consider all the possible sources of growth you will be forever trapped with less than accurate forecasts. The techniques for understanding growth presented in Chapter 4, “Dimensions of Capacity Growth,” complement the techniques for predicting utilization in Chapter 3 to complete your understanding of how capacity is managed.

Part II, “Best Practices in Capacity Management,” focuses on the actual deployment of an effective capacity management program. By *program* we don’t mean a specific piece of computer software or any specific tool. Instead, the capacity management program is an effective process managed and executed by trained staff and automated with appropriate tools to produce useful and accurate data. All four components (process, people, tools, and data) are essential, and the goal of Part II is to provide balanced treatment of all four of these components.

We begin Part II with data. In Chapter 5, “Establish the Capacity Management Information System,” you’ll learn about the Capacity Management Information System (CMIS), which is the database used to store all capacity management data. This database is a fundamental component of an effective capacity management program, and since most organizations I’ve encountered don’t have a working CMIS, I go into significant detail on what it should include and how it should be organized.

The data theme continues in Chapter 6, “Define and Manage Capacity Plans,” with a deeper look at a particular kind of entry in the Capacity Management Information System, the Capacity Plan. The chapter includes in-depth descriptions on how to create capacity plans, what they should include, and how to maintain them so that they can be useful documents for your organization. There is a section on how to store capacity plans so that they can be an integral part of your CMIS.

Chapter 7, “Staff the Capacity Management Team,” puts the focus squarely on the people who will be involved in your capacity management program. You will need one set of people to implement capacity management and most likely a separate set of people to manage capacity after the program has been set in motion. Separate roles are described for these two teams, along with some general observations about the skills required for each role. The information in Chapter 7 will enable you to determine whether the same people are involved with both teams.

When you understand the data you need and have people to implement the program, you are ready to deploy the process. The *ITIL Service Design* book provides a great understanding of what the fundamental building blocks of a capacity management process should be. Rather than restating that material, Chapter 8, “Implement the Capacity Management Process,” gives you practical advice on how to set that process in motion. I assume you have no process or procedures today and describe how to get them implemented and start the road to maturity.

In Chapter 9, “Relate Capacity and Performance,” we extend the process discussion to investigate the relationship between capacity management and performance management. I make the case that performance management is a necessary subset of the entire capacity management process, and provide some ideas of how to implement a performance management subprocess while focusing on capacity management.

Chapter 10, “Choose Capacity Management Tools,” and Chapter 11, “Produce Capacity Reports,” focus on the tools and outputs of your capacity management program. In Chapter 10 we focus specifically on what parts of the process are typically automated. You won’t find any specific tool recommendations, but instead you will find a wealth of detail on the tools marketplace and characteristics you should consider when shopping for capacity management tools. Even if you already own tools that provide some functions, Chapter 11 will help you understand other areas you might be able to automate in the future.

In Chapter 11, I continue the tools discussion with a specific focus on reports. You will find specific ideas for reports that you might want to use, along with a rationale for why those reports have been important to other organizations. You’ll learn that there are reports about capacity and also reports that describe the health of your capacity management program. Both kinds are important, and Chapter 11 will help you get the right reports to the correct audience.

Part III, “Common Issues in Capacity Management,” delves into some specific issues that arise around managing capacity. This section might appear to be a hodgepodge, but I’ve tried to cover topics that have caused difficulty for many of my colleagues and many of the customers I work with. The theme throughout Part III is integration and making the capacity management program part of a fully functioning IT organization.

The first topic, presented in Chapter 12, is “Business Capacity Planning.” ITIL insists that a full capacity management program also plans to meet the needs of the business. But it is sometimes very difficult to get the business units outside of IT to describe what those needs are. This chapter will help you bridge the gap between IT and the business and gives you some hints on what to do when the business doesn’t cooperate so well.

Chapter 13, “Smoothing the Order Cycle,” explores the relationship between capacity management and IT procurement. Much of the cost benefit of capacity management comes from avoiding IT spending, so this chapter focuses on how to use the techniques of capacity management to avoid spending as long as possible while not running out of capacity. The important concept of a “reorder level” is applied to capacity management in Chapter 13.

Another important area of integration is between the capacity management team and various IT project teams. Since all new projects require capacity and many of them add capacity, there is a natural affiliation between project management and capacity management. This relationship is explored in Chapter 14, “Capacity Management in a Project Context.”

The final chapter takes a wider view to explore the relationship between capacity management and other IT disciplines described by ITIL. In Chapter 15, “Integrating Capacity Planning with IT Processes,” you’ll learn how to integrate capacity management with several other process areas. The integrations described here will help whether or not those other process areas are already mature, or you will implement them for the first time several years from now. The common theme is that capacity management is made stronger as it is integrated with other parts of your IT operations.

Acknowledgments

The creation of a book is a long, slow marathon. Without the help and encouragement of the other runners, there is no way to get to the finish line. I want to thank my team of very dedicated technical reviewers—Brian and Charles—for the many hours of reading my opinions and turning them into facts that the reader can rely on.

The IBM® Press team has again proved both their professionalism and their passion for helping authors succeed. My heartfelt thanks go to the team for helping me through the process as I juggled my writing with my regular job.

Of course, my biggest thanks are saved for those who once again have allowed me to turn their businesses into laboratories. My customers and I have learned this material together, and not without some mistakes along the way! I sincerely appreciate the patience and support of the customers I've worked with, especially those in Minneapolis, Camden, Amsterdam, and Detroit. You know who you are.

This page intentionally left blank

About the Author

Larry Klosterboer is a professional IT architect specializing in service management. He works for IBM Global Technology Services as the lead architect for large, complex outsourcing customers. Larry has more than 20 years of experience in IT operations and service delivery, spanning technologies from mainframe to networking to desktop computing. Much of his career has been spent in helping organizations implement service management processes and tools, which is to say undoing the mistakes that he and others have made in this area!

This page intentionally left blank

Define and Manage Capacity Plans

One of the key pieces of information that should be stored in your capacity management information system is the capacity plan. The ITIL Service Design book offers a great high-level look at the contents of a capacity plan. It assumes, however, that you will create a colossal document that includes all the capacity details for all your services and components. Then the book goes on to say you should take the time to create an executive summary because the main document will be so large that very few will actually read it!

This chapter goes beyond the ITIL documentation to describe a working formula for capacity plans. It suggests that you create more customized plans for those areas that really need detailed plans and keep them current through a repeatable process. You will learn the details of what goes into a capacity plan and how and when to create your plans.

Scope of a Capacity Plan

As the name implies, a capacity plan is a plan for how to manage the capacity of a specific IT service. Although you could attempt to create a single plan that defines the current and future capacity needs for every IT service you manage, it would soon break down into a series of individual chapters by service. So why not create an individually managed plan for each service from the outset? The scope of each plan is thus the service that is defined in that particular plan document.

Service Capacity Plans

Throughout the preceding chapters, we've been using the geography analogy from Chapter 2, "The Geography of Managing Capacity," to describe the two types of resources for which you must manage capacity—IT components and IT services. You've seen examples of both, but now it is time for a more specific definition of an IT service. The ITIL framework describes an environment in which

your IT organization creates an overall strategy and then designs, implements, and manages a set of services that you offer to the wider organization you serve. IT services offer specific business value to help your organization achieve its goals. Each service has a definition, one or more quality measures called service levels, and potentially a cost to those who receive the service.

Using this definition, the reason for capacity plans based on IT services becomes clear. If IT were a separate company, your IT services would be the way you made money. Running out of capacity to continue a service would restrict your ability to generate more revenue. So clearly you will want to have a concrete, actionable plan to ensure that your IT services do not run out of capacity. If you have no more service to offer, why should IT need to continue to exist?

You know you need to create capacity plans for your IT services, but how do you put some boundaries around what a service entails? A typical IT service blends hardware, software, data, and labor effort in a unique way to deliver the service that the organization needs. For example, consider an IT service that sets up a new workstation when an employee joins the organization. You either purchase a new workstation each time or have some workstations on hand, so that is one capacity pool. Each workstation requires several software licenses for an operating system, an office product, and maybe other applications, and those licenses can represent additional capacity pools to be managed. But to complete the service, you also need technicians who can unpack the hardware, install the software, and deliver the package to the new user. The overall service can get quite complicated, so knowing where to draw the boundary of the service capacity plan can be difficult.

As a rule of thumb, you probably want to exclude labor components and focus on the hardware and software pieces that make up your service. Labor capacity is the domain of your human resources team and not really the subject of IT capacity management until you have a very mature capacity management program and a very good relationship with your HR team. After you have identified the most important hardware and software components, you need to define the relationships between them in a way that helps you understand the capacity of the service. These relationships should already be available as part of your configuration management system. Stop when you get to components that are really not integral to providing the service you are considering.

Of course, many of your IT services are delivered using shared components. A single server might be part of multiple different IT services, and network components are likely to be part of almost every service you deliver. If you have a way to allocate the capacity of a shared component to the different IT services it provides, then you can include these shared components along with the IT service. Otherwise, you need to create capacity plans for shared components separately from the plans for your IT services.

Component Capacity Plans

If you create capacity plans for each of your IT services, you will have most of your components already covered. So why would you define component-based capacity plans? These plans are needed only when you have components that do not participate directly in any specific IT service or for those areas where a component is shared among many or all of your IT services. In Chapter 5, “Establish the Capacity Management Information System,” for example, you learned about the

capacity management information system. Although capacity management, incident management, change management, and other IT service management systems are vital to IT, they are not directly related to any specific IT service that you offer to the wider organization. Because these systems are shared across all IT services, you should define a specific component-based capacity plan for them separate from your IT service capacity plans.

The scope of a component capacity plan is only slightly different than the scope of a service capacity plan. A component plan is more narrow because it needs to consider only a single capacity pool, or for a complex component perhaps two or three pools. Because of this more narrow focus, a component capacity plan is also more specific. Many times the utilization and total capacity information come directly from measurements done by automated tools, so the predictions in the plan of when capacity runs out can be much more precise than those of service capacity plans. In general, component capacity plans tend to be more technical and detailed than service capacity plans.

Sometimes it makes sense to link component capacity plans to IT service capacity plans. If a component is shared only between three or four different services, you might want to mention those services in the component capacity plan. It helps when reading the plan to understand that the capacity defined in the component plan is being allocated to a specific set of IT services.

Table 6.1 compares and contrasts IT service capacity plans and component capacity plans.

Table 6.1 Comparing Service and Component Capacity Plans

Service Capacity Plan	Component Capacity Plan
Variety of measurements	Single direct measurement
Unknown total capacity	Known total capacity
Contains options for capacity growth	Normally one known growth option
Utilization trends are estimated	Utilization trends are accurate
Contains business details	Contains technical details

How Many Plans?

The description of service and component capacity plans may leave you wondering whether it wouldn't be better to just create a single capacity plan after all. It might seem that managing this plethora of plans will cause extra confusion and added work, but that isn't the case. If you have really committed to managing IT as a set of services, you will have many other documents aligned by service, and the capacity plan will just be part of the entire set. For a very large organization or one with a high degree of complexity, the service owner manages the capacity plan along with other documentation for the service. In that case the service owner relies on the capacity management team for assistance.

You should also be aware that not every piece of your IT environment necessarily needs a capacity plan. Remember that capacity planning is all about making better decisions. There are likely to be areas where capacity decisions do not need to be made. For example, many organizations find that local area networks seldom have capacity issues, so they choose not to define or manage capacity plans for the LAN components. Similarly, personal workstations probably don't need capacity plans because shortages of workstation capacity do not significantly impact the IT organization or its ability to provide services to the business.

Your set of capacity plans is likely to grow over time as you get more experience in capacity planning and expand the range of decisions that can be made with solid capacity data. You certainly want to create plans for your most frequently used IT services first. Next you should define plans for those shared components that are most critical or that would have the most impact if they ran out of capacity. Finally, work on the less critical components and the less frequently used services.

The bottom line is that you should create capacity management plans with an eye to their value. If there won't be value in having a plan, don't create one. On the other hand, don't hesitate to create plans if you think you might need them. There is nothing worse than telling the business they need to wait a week or more for an important service because you didn't think you needed to manage capacity for that service!

Format of a Capacity Plan

The format of a single capacity plan is defined in Appendix J of the service design book. The format includes 11 separate sections covering all aspects of the unified capacity plan. In this section I expand on this basic format and provide some real-world experience that will help you to make your capacity plans complete, concise, and easy for your organization to read.

The Essential Elements

Although the service design book offers good advice for what makes a complete capacity plan, there are certain essential elements that should not be missed. Those elements are described here and depicted graphically in Figure 6.1.

Introduction

Of course, every capacity plan document should begin with an introduction. Somewhere in the introduction you should establish which elements the plan covers and what significant changes have taken place since the previous version of the plan. The introduction is also a great place to preview any significant issues that are described in the plan and to make a call for action if any action is necessary. Although the introductions to all of your capacity plans are likely to be similar, there should be enough differences and distinctions that the opening of the plan doesn't read like a template. If you find you are spending more than a page or so on the introduction, you are probably not summarizing well enough.

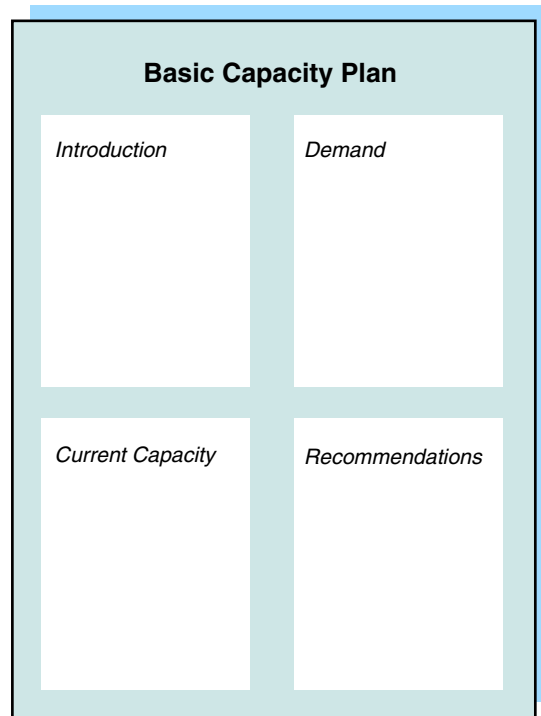


Figure 6.1 A capacity plan has four essential elements.

Total Available Capacity

After the introduction, the capacity plan should define the currently available capacity for the service or component. For IT services, this might include some theoretical information on what the upper limits might be and how they could be calculated. For a component capacity plan the task is much simpler because you can simply state the units of measure and define the real physical size of the capacity pool. For either type of plan, it is important to define the upper limits of capacity so that the rest of the plan, including any recommendations for expanding those upper limits, makes more sense.

In addition to total capacity, you will want to describe any capacity issues that are occurring with the service or component. If you have outstanding performance or capacity concerns, document them as part of the plan. This provides a strong base for the recommendations that you will make later in the plan.

Past Utilization and Future Demand

The majority of the capacity plan focuses on the current and anticipated capacity demand. It is this analysis of the demands facing a particular service or component that takes the most effort

and provides the information needed for decisions. This section requires more detail and thus more organization than the other sections of the plan.

Your capacity plan should review trends in utilization. Document the long-term utilization trend, such as monthly averages for the past 18 months or at least for the past year. You should also document the trend in peak utilization if your tools are capable of gathering that. Often the peak utilization is more interesting than the average because you can learn more about what puts stress on your capacity. Understanding and working with peak utilization helps you to mix the right workloads together so that they can share capacity and each have available resources to meet their peak demand.

The capacity plan should also document shorter-term utilization trends. Profile an average day by showing the utilization for every hour during the day. Show an average and a busy hour by showing the utilization for every few minutes during the hour. All these trends provide the data needed to make capacity decisions about the service or component you are documenting.

The trend data show the history and one possible glimpse of the future, but you should also document any projected changes in utilization. As described in Chapter 3, “Understanding Capacity Demand,” demand might come from IT projects or from business activities. Either way, whatever is known of the future resource needs should be captured in the capacity plan as more data with which to make decisions.

Observations and Recommendations

You should round off the capacity plan with analysis of the data. Look deeply at the trends and the upcoming demand, and see whether you can determine when new capacity is needed. Conversely, look at opportunities to save money by consolidating existing capacity, satisfying need with virtual servers, or even decommissioning systems that are no longer needed.

Don’t simply observe these opportunities. You should also elaborate on them. Describe what should be done in sufficient detail that someone can create a project proposal or scope statement. Project potential cost savings or the capacity of a newly consolidated system. If you propose acquisition of new hardware, you should specify the configuration to be ordered and define how much new capacity will be created. Given the current trends, how long will that new capacity last?

The recommendations here should be reasonable and in line with the standards of your organization. Don’t recommend purchase of a mainframe when a simple Unix box will do the job! Base your recommendations on the data presented in the capacity plan, and provide sound reasoning for why they are the right next steps.

As part of the observations and recommendations section of the capacity plan, you will also want to provide some follow-up on recommendations that were part of earlier versions of the plan. Did the recommendations get implemented? If so, did they resolve the concerns or head off any incidents? Review of past success strengthens your current recommendations, and review of past failures makes sure that you work harder on your current recommendations.

The Right Level of Detail

Now that you understand the basic pieces that make up the capacity plan, you might be wondering about the depth of detail that should go into the document. Although a capacity plan is fundamentally a technical document, you will not want to make it so detailed that it is impossible to read. You should strive for clear explanations without added complexity.

For a casual reader of the capacity plan, the introduction and recommendations are the most interesting. Casual readers are typically IT managers or executives, or perhaps even business unit managers who are particularly impacted by IT. These readers will be interested in knowing when capacity concerns will impact IT services and what the costs will be to alleviate those concerns. So the details in the introduction and recommendation sections should be sufficient to enable the casual reader to understand quickly and completely what the issues are and how they can be resolved.

The majority of the readers of your capacity plans will not be casual, however. They will be the technicians and engineers who provide and manage your IT capacity. These readers will want more than issues and recommendations. They will want to understand the details behind the current issues and the concrete steps to implement the recommendations. These readers will peruse the introduction and analysis, and then dive deeply into the current capacity and utilization sections. These readers may want details even beyond what your tools can produce. But remember that the engineers have real jobs to do and reading capacity plans is not their major focus. So, again, the rule is to be concise and provide the details that support the current position and recommended actions. Any details beyond those represent effort that you have wasted in writing the plan and that your technical readers have wasted in reading the plan.

There is one more audience to consider. The person or people who have to acquire new capacity will look at your plans with a completely different view. They aren't particularly interested in current capacity or utilization. They don't even care about the recommendations very much, other than those that drive new purchases. When new acquisitions do need to be made, however, this team will want enough detail to take action. There really isn't much purpose to a plan that says "buy another server." Instead, the plan needs to spell out exactly what model of server needs to be purchased and what features or components need to be acquired with that server. In other words, the procurement team needs to see a complete configuration that is ready to order. You don't want to end up with an approval to purchase new capacity and then waste time by not having the details of what needs to be ordered. Of course, planning in this light will also cause you to really consider the recommendations you make. Knowing that your recommendations need to go in front of someone to make investment decisions should cause you to really be sure the purchases are justified.

Maintaining Capacity Plans

Capacity plans are living documents. They need to be actively managed as your organization and its needs change. This section describes the procedures you can use to make sure your capacity

plan is always ready to support the decisions that need to be made. By thinking about maintenance before plans are made, you will never be in a position to have to refresh dozens or even hundreds of out-of-date plans at the same time.

Periodic Reviews

The first issue to consider is how to keep capacity plans current as your organization's IT needs and projects change. Every organization goes through normal cycles when they need more capacity or less capacity. Therefore, every capacity plan is incorrect at least some of the time. You should conduct periodic reviews of each of your plans to bring them back in line with the actual issues, utilization, and capacity of your IT infrastructure.

Most organizations find a quarterly cycle to be best for capacity plan reviews. This allows enough time to go by for changes to happen, but doesn't let the plans get so far out of date that they are not effective when needed. Three months should be adequate time for most organizations to consider the recommendations made by the capacity plans and to implement those that are most critical. If your organization is particularly small or has very infrequent changes, you might consider a longer cycle, but certainly no more than every six months. Conversely, for very large or very dynamic organizations you might want to look at capacity plans more frequently. One very large client I worked with broke the capacity plans into areas by technology and had a monthly meeting for each area to review all the capacity plans that impacted that area. I cannot imagine needing a review any more than monthly.

After you've defined the review cycle, you need to establish a mechanism that reminds you when reviews are needed. With dozens or even hundreds of separate plans, you need to create a capacity plan review schedule that indicates which plans are up for review at what time. The best way to do this is with a document management system with built-in review policies. If you don't have a good system, you will most likely need to create an inventory of each of the capacity plans tracking their owner (more about that later), their last review date, and their next scheduled review date. Then as a capacity manager you are responsible for reviewing that inventory and setting up the appropriate reviews. Regular reviews must be a high priority because the expense of starting over again with capacity plans can be steep.

What should you look for as you're doing a review? You should review the pieces that change most frequently, which include the utilization and the analysis sections. The utilization either confirms or contradicts the analysis you have done in the past. If your predictions of the future were reasonably accurate, your analysis should still be sound. On the other hand, if you find that actual utilization has differed dramatically from what you predicted, you may want to read Chapter 3 again and find a more accurate way to predict demand. The entire validity of the capacity plan is based on the accuracy of your utilization predictions, so you should take every opportunity to learn to predict capacity demand more accurately.

The analysis and recommendations will likely change with every review of the capacity plans. If the recommendations were implemented, you will have new capacity and those recommendations can now be removed from the plan. For recommendations that were not adopted,

however, you will want to review whether the recommendation is still valid, and if so, strengthen it to show why it should be adopted soon.

Capacity plan reviews should take place in a joint meeting between the technicians responsible for managing the capacity pool, the capacity manager, and someone with financial authority responsibility for the capacity pool. The technician is generally able to document how accurate the utilization predictions were, the capacity manager can describe any activities that have changed the total capacity or impacted the recommendations in the plan, and the financial manager can indicate which new recommendations are likely to get funded. This meeting does not need to take a long time or be extremely formal—the participants just need to touch base to agree together on the changes to be made to the plan.

In lieu of an actual meeting, it is possible for the capacity manager to update the plan with recommended changes and have the other two approve those changes through email. This removes some of the interplay that is likely in a meeting, but reduces the time commitment that each person must make. In many cases these “off line” reviews are needed because it can be difficult to organize everyone’s time such that they can attend the reviews. Making your reviews organized and helpful to the attendees might help them prioritize their calendars to attend the reviews in person.

Coping with Major Changes

There may be changes needed in your capacity plans that are outside of the normal day-to-day activities that your IT group pursues. Some significant changes require more rework and deeper analysis than the norm. In this section we investigate some reasons you might need to significantly rework one or more capacity plans.

Of course, the initial cause of major rework is the fact that you don’t have any capacity plans at all! If you haven’t begun this discipline of documenting plans for each of your major IT services and significant shared components, you have a lot of work in front of you. By now, you should have learned enough to create the first drafts and get them into a regular review cycle. The value of capacity plans becomes greater as you mature them through many review cycles, so begin to draft your plans now.

You shouldn’t ignore the value you can get from early drafts. Even though you know that the capacity plan gets better as it matures, you should not withhold early versions from your organization. The maturity you’re looking for comes only from the wide exposure of people who will really use your plan. Don’t wait for perfection because it will never come while the plan is still private.

Another cause of significant new capacity planning work is the initiation of a new IT service. During the planning for the service, you should have defined enough information to establish an initial capacity and some projections of how quickly that capacity will be used. The initial capacity plan should document those along with some projections of when it might be time to grow beyond the capacity initially deployed for the service. You should expect the first capacity plan for any new service to be flawed. Having a plan that you can revise leads to much better

plans over time. Starting with nothing ensures that you never move toward an accurate and useful plan.

Of course, the opposite of a new service is the discontinuation of an existing service. Frequently, capacity demands are shifted when a service is discontinued. For example, imagine that your organization has decided to stop using Websphere Application Server (WAS) as an application-enabling technology and starts insisting that all developers use Apache Tomcat instead. You will create a sunset plan that removes all instances of WAS while moving critical applications over to Tomcat. This causes rework to capacity plans for both services. Eventually, you will retire or convert the last of the WAS applications and will be able to retire the WAS capacity plan, which means that the Tomcat plan describes sufficient capacity for your needs. There are many scenarios in which you will update two plans to show that capacity of one type is decreasing while capacity of another is increasing.

Another scenario that can create big changes in your capacity plans is a technology change. For example, if your organization was using VMware to host virtual Windows® servers but decided to change to Microsoft as the virtualization engine, you'd be facing a technology change. Although this probably doesn't impact the services you provide to your business, it certainly impacts utilization and available capacity. Most likely you will need to use a different tool to measure utilization, and you probably will want to reassess the number of virtual servers you host per physical server. Those ratios will affect the total capacity available to host virtual servers. This same kind of scenario happens anytime you change the technology that provides capacity to your IT services. When these changes happen, you almost need to begin from scratch to create a capacity plan that makes sense.

Storing Capacity Plans

As a final detail, we consider the options for storing your capacity plans. If you have an advanced document management system already in place, you may not need to worry about this detail. If you are still managing documents with a variety of local hard disks and shared file systems, read on. You'll learn some practical tips for keeping your capacity plans organized and available, and you may be able to use some of these same techniques for other documents as well.

Format of the Plans

Earlier in this chapter, you learned which elements are important to a capacity plan. Now it is time to consider the container that holds those elements. Most organizations settle on a capacity plan in a word processing document with tables and graphs representing utilization data. The free format of a document enables an introduction and recommendations to be drafted as part of the plan while the tables and charts convey the structured data related to the service or component being addressed.

Because capacity plans are simply documents, it is important to ensure that they don't end up sitting on someone's hard disk or in a file share somewhere. Those sources are notorious for being difficult to manage and restricting access. The best place to keep your documents is as

attachments within the capacity management information system itself. If your CMIS software allows attachments, the issue is settled because that is where all capacity plans should be kept.

Of course, not all CMIS software packages allow attachments or can handle large blocks of unstructured data. If you find yourself in this situation, your next best alternative is to create a field in the CMIS that enables you to describe or point to the documents as they are being managed elsewhere. If your software allows universal resource locators (URLs), you can place those into the CMIS as links to enable users to launch the capacity plan in context while using the CMIS. The easier you can make it to find and read the capacity plans, the more they will be read.

As a final resort when nothing else is available, create your own index to the capacity plans manually. This could be as simple as creating a spreadsheet with a single line for each capacity plan that indicates the name of the plan, which element in the CMIS it refers to, and where the file containing the plan can be found. In the CMIS you can then create a field for each service and component that indicates the identifier of the corresponding row in the index spreadsheet. This kind of manual index can be laborious to maintain, but the effort is rewarded as you see your capacity plans becoming more integral to the way the organization manages capacity.

Over time, you should strive to define a set of data elements that exist in each of your capacity plans. If you can gradually move away from free-form text and toward structured text, you can do much more with the capacity plans. You may never arrive at the point where your capacity plan fits nicely within the columns and tables of a relational database, but you should definitely organize as much of the data as you can to help in searching, reviewing, and updating your capacity plans.

Maintaining Version Control

Regardless of where you store the capacity management plans, you must be sure to exercise control of changes. Nothing will derail your efforts quite as quickly as confusion over which version of a plan is valid or where to find the latest version. Since capacity plans undergo frequent revisions, you need to define a version management strategy up front to eliminate these problems.

The best practice for version control is to ensure that within each document is a table for tracking changes. The table should include columns to indicate who made the change, when it was made, and what the nature of the change was. This table should be updated as a habit whenever a change is made to any capacity plan.

If you have the luxury of having a team of capacity managers, you may also need a system to indicate who has control of each plan. In the best possible world you have access to a document or source code control system such as Documentum or Rational® ClearCase®. Those systems allow you to “check out” a document and ensure that two people cannot make changes concurrently. If you don’t have a system that allows you to manage changes to documents, you can accomplish the same thing by using the index spreadsheet identified in the preceding section and simply adding a column indicating who controls the document at any point in time.

Whichever system is used, it is imperative that you control changes to the capacity plans. Only through careful management of the revisions will they become more accurate and more helpful over time.

Summary and Next Steps

Capacity plans provide the capacity management team with the opportunity to analyze the mountain of data they work with every day and make solid recommendations to the IT management team. This chapter has described capacity plans and provided some insight into how your organization can create them.

We started with an overview of what makes up a good capacity plan. You learned that, in addition to specific data elements such as utilization and capacity limits, a solid plan should also include predictions and analysis. You should create a separate plan for each major IT service and for each significant IT component, with each plan providing an in-depth approach for what to do when capacity is too high or too low.

We considered the way to format your capacity plans. You learned that although data can be in the form of a table or structured text, your analysis and recommendations will almost always be free-form text within a document of some kind. You should provide an overview for casual readers, but also provide technical depth to justify the recommendations you make within the plan.

We considered how to manage capacity plans and saw that they follow a life cycle that can be tracked through effective document management practices. Capacity plans should be reviewed regularly and updated when changes are needed. Minor changes can be bundled together into a regular release cycle for the document, and major changes should be planned and implemented as part of the major IT change that is causing you to rethink the capacity plan.

As indicated in Chapter 5, capacity plans should be stored in the CMIS. If your CMIS tool allows attachments, you should store the actual document there. If not, you should at least create some kind of index within the CMIS so that users of that repository can easily locate and view your capacity plans.

Now that we've addressed the two most misunderstood ITIL capacity management terms (CMIS and capacity plan), the next chapter returns to fundamentals. We explore how to define and staff the roles you need to create an effective capacity management team.

Index

A

- accuracy
 - of capacity forecasting, 34
 - of trends, 138-139
 - of utilization data, 12
- acquisition
 - capacity policies, 96-97
 - cycles, smoothing out, 7
- adding
 - capacity, requirements of, 170
 - servers, 18
 - services, 45
- adoption of IT-level processes, 91-93
- agents, 123
- aggregate reporting, 28-29
- agility, planning, 11
- alternative infrastructure, 9
- analysis
 - capacity analyst, 82-83
 - lack of, 13
 - peaks and valleys, 113-114
 - tools, 109
 - utilization, 12
- applications, deployment of, 43

- applying CMIS (capacity management information system), 60-61
- approvals, 102
- architecture
 - capacity and performance, 171-172
 - growth, 174-175
- assets
 - disposing of, 167
 - processes, managing capacity, 101-103
- assigning capacity management, 177-179
- attacks, terrorist, 9
- attributes of IT-level processes, 93-94
- audience, determining for capacity plans, 69
- automation
 - performance management, 117-118
 - tools, 110
 - TSAM (Tivoli Service Automation Manager), 141
- availability management, integration with, 181-183
- available capacity, 67

- avoiding
 - cost of avoidance, 10-11
 - projecting, 36
 - through increased utilization, 35
 - purchasing additional capacity, 7
 - running out of resources, 7
 - upgrade costs, 11

B

- benefits, 10. *See also* costs
 - of availability management, 183
 - of business capacity planning, 150-151
 - of capacity management, 10-12
 - of change management, 187
 - of configuration management, 185
 - of incident management, 189
 - of release and deployment management, 193
 - of service continuity management, 192

blade servers, 16. *See also*
 components
 blended capacity forecasts,
 33-35
 BMC Management, 109, 125
 boundaries of capacity pools,
 16-17
 breaking points, 110
 British Office of Government
 and Commerce, 4
 buffers, capacity, 157-159
 building, tools, 125
 business capacity planning
 implementation, 150-153
 integrating with IT capacity
 planning, 153-155
 managing IT capacity
 planning, 155-156
 measurement of, 12
 scope of, 145-149
 business event forecasts, 32-33
 business-based trends, 29-30
 business-driven portfolios,
 30-31

C

CA NetQoS SuperAgent, 109
 calculating utilization, 99
 Capability Maturity Model
 Integration (CMMI), 91
 capacity
 analyst, 82-83
 buffers, 157-159
 business planning
 implementation,
 150-153
 integrating with IT
 capacity planning,
 153-155
 managing IT capacity
 planning, 155-156
 scope of, 145-149
 components, tracking,
 119-123
 data, 54-56, 83-84

demand
 blended capacity
 forecasts, 33-35
 business event forecasts,
 32-33
 cost management
 forecasts, 35-36
 portfolio-based forecasts,
 30-32
 trend-based forecasts,
 27-30
 growth
 architecture, 174-175
 managing, 39-45
 incidents, tracking, 139-140
 management
 costs of, 10-12
 effect of virtualization on,
 22-24
 ordering discipline, 165
 plans as deliverables, 169
 purpose and goals of, 6-8
 performance, 105-108
 extending, 109-113
 system architecture,
 171-172
 planner, 85
 process owner, 76-77
 service owner, 81-82
 planner, 85
 planning, 23, 56, 100-101
 availability management,
 181-183
 change management,
 185-187
 configuration
 management, 183-185
 evaluating, 140-141
 format of, 66-73
 incident management,
 187-189
 maintaining, 69-72
 performance, 116
 at project time, 173-176
 release and deployment
 management, 192-193
 scope of, 63-66
 service continuity
 management, 190-191
 storage, 72-73
 policies
 acquisition, 96-97
 defining, 94
 incidents and
 changes, 97
 monitoring, 95-96
 planning new projects, 98
 pools
 boundaries of, 16-17
 defining, 16
 granularity of, 17-19
 managing, 19
 virtualization, 23
 procedures, creating, 98-101
 processes
 managing assets,
 101-103
 owners, 76-77
 reclaiming, 166-167
 reorder levels, setting correct,
 159-162
 reports, 133
 components, 134-135
 services, 136-137
 trends, 135-136
 requirements, adding, 170
 reusing, 167
 reviewing, 99
 service owner, 81-82
 sharing, confluences and,
 20-21
 streams
 defining, 19-20
 managing, 22
 value of, 21
 tests
 executing test cases,
 172-173
 utilization, 173-174
 trend accuracy, 138-139
 utilization trackers, 113
 viewing, 123-125

capacity management
 information system. *See* CMIS
 central processing units (CPUs),
 51, 54, 127
 change management, 9
 integration with, 185-187
 capacity
 policies, 97
 plans, dealing with, 71-72
 chargebacks, 11
 charts, creating procedures,
 98-99
 Cisco
 routers, 121
 Works, 122
 CMIS (capacity management
 information system)
 applying, 60-61
 contents of, 52-56
 designers, 78-79
 implementation of, 57-60
 integrated service
 management, 50-51
 purpose of, 49
 reporting, 52
 repository of, 49
 tools, 128-129
 CMMI (Capability Maturity
 Model Integration), 91
 CMS (configuration
 management system), 50
 collection, documentation
 of, 99
 common use, boundaries of
 capacity pools, 17
 completeness of capacity plans,
 evaluating, 140-141
 component servers (CSs), 148
 components
 accuracy of utilization
 data, 12
 capacity, 54-56
 plans, 64-65
 reports, 134-135
 tracking, 119-123
 trends, 135-136

grouping, 16, 124
 hierarchies, 153-154
 refreshing, growth by,
 40-42
 trends, 27-29
 computer resources, wasting, 6
 concentrators, VPNs (virtual
 private networks), 137
 configuration
 IT-level processes, 91-93
 integration with, 183-185
 management, 9
 configuration management
 system (CMS), 50
 confluences and shared capacity,
 20-21
 consistency
 measurements, 151-152
 tests, 98
 of utilization data, 12
 consolidation projects, 60
 contents of CMIS (capacity
 management information
 system), 52-56
 continuity, service, 9
 control, maintaining
 version, 73
 costs
 avoidance, 10-11, 35
 of business capacity planning,
 150-151
 of capacity
 management, 10-12
 pools, 17
 cost-containment, 162
 management, forecasting,
 35-36
 performance management,
 106
 reduction through
 decommissioning and
 recovery, 35-36
 of tools, 121, 125
 CPUs (central processing units),
 utilization, 51, 54, 127
 CSs (component servers), 148

customizing
 capacity, 100
 tools, 121
 cycles. *See also* life cycles, 4-6
 order
 capacity buffers,
 157-159
 interval selection,
 163-165
 reclaiming capacity,
 166-167
 reorder levels, 159-162
 planning, 32
 portfolios, 31

D

databases, 20
 data centers, 16, 141
 decision-making
 capacity, 60
 CMIS (capacity management
 information system), 52
 decommissioning, 167
 cost reduction through, 35-36
 defining
 business capacity, 146
 capacity
 pools, 16
 streams, 19-20
 test cases, 172-173
 goals, 8
 performance management,
 106
 policies, 94
 acquisition, 96-97
 incidents and
 changes, 97
 monitoring, 95-96
 planning new
 projects, 98
 projects, adding capacity
 requirements, 170
 requirements, 57
 deliverables, planning capacity
 as project, 169

demand

- capacity
 - blended capacity forecasts, 33-35
- business event forecasts, 32-33
- cost management forecasts, 35-36
- portfolio-based forecasts, 30-32
- reclaiming, 166
- trend-based forecasts, 27-30
- future, 67
- growth by, 40-41
- dependency processes, 9
- deployment
 - applications, 43
 - reorder levels, 160
 - sharing, 44
- depth of detail in capacity plans, 69
- detection of growth, 40
- determination of capacity buffers, 157-158
- development
 - of capacity management skills, 87
 - of teams, 87
- diagnostics, performance, 111-113
- disasters, service continuity, 9
- disposing of assets, 167
- documentation, 71
 - formatting, 101-102
- policies, 94
 - acquisition, 96-97
 - incidents and changes, 97
 - monitoring, 95-96
 - planning new projects, 98
- procedures, creating, 98-99
- storage, 101-102

E

- editing
 - capacity plans, 71-72
 - tracking, 103
- elements
 - component exception reports, 134
 - of capacity plans, 66-68
- employees
 - capacity management assignments, 177-179
 - implementation roles, 75-76
 - capacity process owner, 76-77
 - CMIS designers, 77-78
 - process engineer, 78-79
 - project managers, 79-80
- operational roles, 81
 - capacity analyst, 82-83
 - capacity data manager, 83-84
 - capacity planner, 85
 - capacity service owner, 81-82
- skills, 86-87
- training, 59
- engines, virtualization, 23.
 - See also* virtualization
- ERP (enterprise resource planning), 150
- estimations, capacity utilization, 173-174
- ESX host servers, 28
- evaluating capacity plans, 140-141
- events
 - capturing, 127
 - forecasting, 32-33
- exceptions, component reports, 134
- extending capacity, 109-113

F

- fastest-growing components, reports, 135
- filtering logic, 134
- financial management, 9-11
- flowcharts, creating procedures, 98-99
- forecasting
 - blended capacity, 33-35
 - business capacity needs, 149
 - business events, 32-33
 - capacity needs, 60
 - cost management, 35-36
 - portfolios, 30-32
 - trends, 27-30
- formatting
 - of capacity plans, 66-73
 - capacity procedures, 98-101
 - documentation, 101-102
 - performance profiles, 114-115
- functional requirements, 92
- future
 - capacity needs, predicting, 8
 - demand, 28, 67

G

- gateways, 127
- gathering data, 58
- goals of capacity management, 6-8
- granularity
 - of capacity pools, 17-19
 - of utilization data, 53
- graphs, trends, 27
- grouping components, 16, 124
- growth, 10
 - architecture, 174-175
 - capacity
 - pool granularity, 18
 - managing, 39-45
 - demand, 40-41
 - project-based, 42-44
 - refreshing, 40-42
 - services, 45

H

- hardware, 99
 - costs, 10
 - virtualization, ordering, 163-165
- hierarchies, business, 153-154
- high-level IT processes, 89-90
 - attributes of, 93-94
 - configuring, 91-93
- history, tracking, 27. *See also* trends
- hosts
 - ESX servers, 28
 - virtual Windows servers, 72
- HP (Hewlett Packard)
 - Open VMS platform, 123
 - System Insight Manager, 122
- human resources, wasting, 6
- Hyper-V, 23
- Hypervisor, 23, 117

I

- IBM
 - iSeries servers, 123
 - Tivoli, 129
 - Tivoli Monitoring, 127
 - WebSphere Application Server (WAS) licenses, 19
- implementation, 8
 - of business capacity planning, 150-153
- CMIS (capacity management information system), 49, 57-60
 - contents of, 52-56
 - integrated service management, 50-51
 - reporting, 52
 - repository of, 49
- high-level IT processes, 89-90
 - attributes of, 93-94
 - configuring, 91-93
- risks, 12-13

- roles, 75-76
 - capacity management information system designer, 77-78
 - capacity process owner, 76-77
 - process engineer, 78-79
 - project managers, 79-80
- incidents, 9
 - capacity
 - policies, 97
 - tracking, 139-140
 - management, integration with, 187-189
- individual units, ordering, 163
- information technology. *See* IT
- innovation-driven
 - portfolios, 32
- integrated service management, 50-51
- integration
 - with availability management, 181-183
 - of business capacity planning, 153-155
- capacity
 - management tools, 128
 - plans, 155
 - with change management, 185-187
- component capacity tracking
 - tools, 121
- with configuration management, 183-185
- with incident management, 187-189
- performance, 116
 - with release and deployment management, 192-193
 - with service continuity management, 190-191
 - service management, 60-61
- interfaces, 8-9
- intervals, selection of ordering, 163-165

- inventories, managing, 19
- IT (information technology), 3
 - high-level processes, 89-90
 - attributes of, 93-94
 - configuring, 91-93
 - portfolios, 31-32
 - processes
 - availability management, 181-183
 - change management, 185-187
 - configuration management, 183-185
 - incident management, 187-189
 - release and deployment management, 192-193
 - service continuity management, 190-191
 - services, 64, 154
- ITIL (IT Infrastructure Library)
 - life cycle of, 4-6
 - version 3, 90-91

J-K-L

- layers of capacity management, 15
- legal library management
 - business process, 147
- levels, reorder, 157-159
 - intervals selection, 163-165
 - reclaiming capacity, 166-167
 - setting correct, 159-162
- licenses
 - Oracle, 20
 - WAS (WebSphere Application Server), 19
- licenses, pools of, 16
- life cycles
 - of ITIL, 4-6
 - of service management, 4-6

lines, trends, 34. *See also* trends
 Linux, 122
 Live Partition Mobility, 19
 load, simulating, 110
 location, boundaries of capacity
 pools, 17
 logic, filtering, 134
 LPARs (logical partitions),
 23, 161

M

maintenance
 capacity plans, 69-72
 performance management,
 106
 version control, 73
 management
 availability, integration with,
 181-183
 business capacity planning,
 155-156
 capacity
 costs of, 10-12
 data managers, 83-84
 effect of virtualization on,
 22-24
 growth, 39-45
 ordering discipline, 165
 plans as deliverables, 169
 pools, 19
 process assets, 101-103
 project time, 173-176
 purpose and goals of, 6-8
 streams, 23
 virtualization, 23
 change, 9, 185-187
 CMIS (capacity management
 information system)
 applying, 60-61
 contents of, 52-56
 implementation of,
 57-60
 integrated service
 management, 50-51
 purpose of, 49
 reporting, 52
 repository, 49

CMS (configuration
 management system), 50
 configuration, 9, 183-185
 costs, forecasting, 35-36
 financial, 9-11
 groups of components, 16
 high-level IT processes,
 89-90
 attributes of, 93-94
 configuring, 91-93
 incident, 9, 187-189
 performance, 105-108
 automating, 117-118
 extending capacity,
 109-113
 tools, 125-128
 release and deployment, 9,
 192-193
 reorder levels, 159
 resources, 17
 services
 integration with, 60-61,
 190-191
 life cycle of, 4-6
 skills, 86-87
 virtualization, 23
 maturity
 processes, 160
 of skills, 87
 measurements
 business capacity, 12,
 147-148
 capacity
 pools, 16
 streams, 22
 trend accuracy, 138-139
 consistency of, 151-152
 of maturity, 140
 performance, 109-113, 116
 services, 123-125
 tools, 51
 memory, utilization of, 54, 135,
 148
 metrics, 12. *See also*
 measurements

micro-partitioning, 23
 Microsoft System Center
 Operations Manager (SCOM),
 53
 minimizing resources, 120
 modeling, 125
 modifying capacity plans,
 71-72
 money, wasting, 6
 monitoring capacity policies,
 95-96
 monthly reports, 140. *See also*
 reports
 multiple data centers, 16

N-O

NAS (network attached storage),
 17
 natural disasters, 9
 Neptune Caplan, 125
 network attached storage (NAS),
 17
 networks, SAN (storage area
 network), 13
 nonfunctional requirements,
 92
 observations, capacity
 plans, 68
 operating systems, 19
 operational roles, 81
 capacity analyst, 82-83
 capacity data manager,
 83-84
 capacity planner, 85
 capacity service owner,
 81-82
 operational turnovers, 179
 optimizing
 capacity, 100, 105-108
 extending, 109-113
 Hypervisor, 117
 Oracle databases, 20
 order cycles
 capacity buffers, 157-159

- capacity, reclaiming, 166-167
- intervals, selecting, 163-165
- reorder levels, 159-162
- OS (operating system) utilities, 121. *See also* tools
- over-subscription, 24

P

- packaging, vendors, 160
- partitions, LPARs (logical partitions), 23
- past utilization, 67
- peaks, 23, 113-114
- performance
 - capacity, 105-108
 - extending, 109-113
 - system architecture, 171-172
 - diagnostics, 111-113
 - integrating, 116
 - management tools, 125-128
 - profiles, 114-115
 - trends, measuring, 116
 - virtualization, 117
 - automating, 117-118
 - Hypervisor, 117
- Performance Monitor, 121
- periodic reviews, capacity plans, 70
- planning
 - agility, 11
 - business capacity
 - implementation, 150-153
 - integrating with IT
 - capacity planning, 153-155
 - managing IT capacity
 - planning, 155-156
 - scope of, 145-149
 - capacity, 23, 56, 100-101
 - availability management, 181-183

- change management, 185-187
- configuration
 - management, 183-185
- evaluating, 140-141
- format of, 66-73
- incident management, 187-189
- maintaining, 69-72
- performance, 116
- planners, 85
- policies, 98
- projects, 169, 173-176
- release and deployment
 - management, 192-193
- scope of, 63-66
- service continuity
 - management, 190-191
- storage, 72-73
- cycles, 32
- ERP (enterprise resource planning), 150
- platforms, 99
- plotting trends, 27
- policies, defining, 94
 - acquisition, 96-97
 - incidents and changes, 97
 - monitoring, 95-96
 - planning new projects, 98
- pools
 - capacity, 56
 - boundaries of, 16-17
 - defining, 16
 - granularity of, 17-19
 - managing, 19
 - virtualization, 23
 - resources, capacity
 - buffers, 158
 - subpools, 23
- portfolios
 - cycles, 31
 - forecasting, 30-32
 - innovation-driven, 32
 - IT, 31-32
- predicting. *See also* forecasting
 - capacity needs, 8, 60, 149
 - demand, 28

- primary infrastructure, 9
- procedures
 - capacity, creating, 98-101
 - training, 59
- processes
 - approvals, 102
 - business, 154
 - capacity
 - managing assets, 101-103
 - streams, defining, 20
 - dependencies, 9
 - engineers, 78-79
 - high-level IT, 89-90
 - attributes of, 93-94
 - configuring, 91-93
 - implementation, 8, 59
- IT
 - availability management, 181-183
 - change management, 185-187
 - configuration
 - management, 183-185
 - incident management, 187-189
 - release and deployment
 - management, 192-193
 - service continuity
 - management, 190-191
- legal library management
 - business, 147
- maturity, 160
- training, 59
- updating, 103
- profiles, performance, 114-115
- projecting cost avoidance and reduction, 36
- projects
 - capacity
 - planning, 173-176
 - as deliverables, 169
 - policies, 98
 - defining, adding capacity
 - requirements to, 170

- managers, 79-80
- project-based growth, 42-44
- purchasing tools, 121, 125
- purpose of capacity management, 6-8

Q-R

- quantity
 - of available resources, measuring, 16
 - of components already used, 16
- Rational Performance Manager, 109
- reclaiming capacity, 166-167
- recommendations for capacity plans, 68
- recovery, cost reduction through, 35-36
- reduction
 - decommissioning and recovery, 35-36
 - projecting, 36
- refreshing components, growth by, 40-42
- release and deployment management, integration with, 192-193
- release management, 9
- reorder levels, 157-159
 - interval selection, 163-165
 - reclaiming capacity, 166-167
 - setting correct, 159-162
- reports
 - aggregate, 28-29
 - capacity, 133
 - components, 134-135
 - services, 136-137
 - trends, 135-136
 - CMIS (capacity management information system), 52

- documentation, 99
- granularity of utilization data, 53
 - trends, accuracy of, 138-139
- repository of capacity information, 49
- request for change (RFC), 186
- requirements
 - capacity, adding, 170
 - CMIS (capacity management information system), 49, 128
 - applying, 60-61
 - contents of, 52-56
 - implementation of, 57-60
 - integrated service management, 50-51
 - reporting, 52
 - repository of, 49
 - component capacity tracking tools, 120-121
 - defining, 57
 - performance management tools, 126
 - process selection, 92
 - service capacity management tools, 124
- resources
 - ERP (enterprise resource planning), 150
 - managing, 17
 - minimizing, 120
 - monitors, 113
 - pools
 - capacity buffers, 158
 - sharing, 24
- reusing capacity, 167
- reviewing
 - approvals, 102
 - capacity, 99
 - documentation, 99
 - peaks and valleys, 113-114
 - plans, 70

- revising
 - capacity plans, 71-72
 - tracking, 103
- RFC (request for change), 186
- risks
 - implementation, 12-13
 - of virtualization, 24
- roles, 86-87
 - implementation, 75-76
 - capacity process owner, 76-77
 - CMIS designers, 77-78
 - process engineer, 78-79
 - project managers, 79-80
 - operational roles, 81
 - capacity analyst, 82-83
 - capacity data manager, 83-84
 - capacity planner, 85
 - capacity service owner, 81-82
- routers, 121

S

- SANs (storage area networks), 13, 17, 147, 166
- scheduling synthetic transactions, 127
- SCOM (Microsoft System Center Operations Manager), 53
- scope
 - of business capacity planning, 145-149
 - of capacity plans, 63-66
- security, storage areas, 19
- selection
 - of capacity buffers, 157-158
 - number of capacity plans, 65-66
 - of ordering intervals, 163-165
 - of processes, 92
 - of tools, 58, 129-131

servers. *See also* components
 adding, 18
 application deployment, 43
 costs, 10
 database, 20
 ESX host, 28
 services
 capacity
 data, 54-56
 plans, 63-64
 continuity, 9, 190-191
 growth, 45
 integrated service
 management, 50-51
 IT, 154
 management
 integrating, 60-61
 life cycle of, 4-6
 tools, viewing capacity,
 123-125
 trends, 29, 136-137
 TSAM (Tivoli Service
 Automation Manager), 141
 sharing
 capacity, confluences of,
 20-21
 deployment, 44
 virtualization, 24
 simulation, load, 110
 skills, 13, 86-87
 source code, control
 systems, 50
 staff
 capacity management
 assignments, 177-179
 implementation roles,
 75-76
 capacity process owner,
 76-77
 CMIS designers, 77-78
 process engineer, 78-79
 project managers, 79-80
 operational roles, 81
 capacity analyst, 82-83
 capacity data manager,
 83-84

 capacity planner, 85
 capacity service owner,
 81-82
 skills, 86-87
 training, 59
 standards, virtualization,
 161-162
 statistics, tools, 109
 steps, ITIL version 3, 90-91
 storage
 capacity plans, 72-73
 CMIS (capacity management
 information system), 49
 CMS (configuration
 management system), 50
 documentation, 99-102
 storage area networks. *See*
 SANs, 13, 17, 147, 166
 storage area security, 19
 strategies, business capacity
 planning, 152-153
 streams
 capacity
 defining, 19-20
 managing, 22
 value of, 21
 pools, sharing, 24
 subpools, 23
 subprocesses, ITIL version 3,
 90-91
 synthetic transactions, creating,
 127
 system architecture, capacity and
 performance, 171-172
 System Center Operations
 Manager (SCOM), 53
 system management
 suites, 122

T

TAADM (Tivoli's Application
 Discovery and Dependency
 Manager), 125

TeamQuest Model, 129
 teams
 operational turnovers, 178
 skills, 86-87
 staff, 86
 terrorist attacks, 9
 tests
 capacity
 executing test cases,
 172-173
 utilization, 173-174
 consistency, 98
 performance, 106-107
 performance tools, 127
 thresholds, 54
 time
 wasting, 6
 scales for performance
 testing, 106-107
 Tivoli Service Automation
 Manager (TSAM), 141
 Tivoli's Application Discovery
 and Dependency Manager
 (TADDM), 125
 Tomcat, 72
 tools
 analysis, 109
 CMIS (capacity management
 information system),
 128-129
 component capacity tracking,
 119-123
 Hypervisor, 117
 integration, 51
 lack of, 13
 peaks and valleys, 113-114
 performance management,
 111, 125-128
 selection of, 58, 129-131
 services, viewing capacity,
 123-125
 utilization, 52-54
 top down portfolios, 30-31
 total available capacity, 67

tracking

capacity

components, 119-123

incidents, 139-140

costs, avoidance and

reduction, 36

measurements. *See*

measurements

revisions, 103

services, 123-125

utilization, 52-54

training staff, 59

transactions, 40, 127

transitions, capacity

management, 177-179

trends

accuracy of, 138-139

business capacity, 149

business-based, 29-30

components, 27-29,

135-136

forecasting, 27-30

future capacity,

forecasting, 34

performance, measuring, 116

reports, 136-137

services, 29

troubleshooting performance,

111-113

TSAM (Tivoli Service

Automation Manager), 141

turnovers, operational, 179

U

units, ordering individual, 163

updating processes, 103

upgrading costs, 11

utilization

accuracy of data, 12

analyzing, 12

business capacity, measuring,

147-148

calculating, 99

capacity tests, 173-174

components, exception

reports, 134

cost avoidance through

increased, 35

CPUs (central processing

units), 51, 127

data, 52-54

memory, 135, 148

past, 67

tracking tools, 119-123

V

V-Motion, 19

valleys, 113-114

values of capacity streams, 21

vendors, packaging, 160

versions

control, maintaining, 73

ITIL, 90-91

viewing capacity, 123-125

Virtual Center, 122

virtual private networks (VPNs),
136

virtualization, 18-19, 60

capacity pools, 23

effect on capacity

management, 22-24

hardware, ordering, 163-165

performance, 117

automating, 117-118

Hypervisor, 117

project-based growth, 44

risks of, 24

sharing, 24

standards, 161-162

virus scanners, 113

VMware, 72, 122

volume ordering, 165

VPNs (virtual private networks),

136

vSphere, 23

W-ZWAS (Websphere Application
Server), 19, 72

waste, avoiding, 6

websites, hosting services, 54

Websphere Application Server

(WAS), 19, 72