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Gupta et al.

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(45) Date of Patent: *Apr. 5, 2011

(54) **FACILITATION OF MULTI-PROJECT MANAGEMENT USING THROUGHPUT MEASUREMENT**

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(73) Assignee: **Realization Technologies, Inc.**, San Jose, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1285 days.

This patent is subject to a terminal disclaimer.

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(22) Filed: **Sep. 7, 2005**

(65) **Prior Publication Data**

US 2006/0010418 A1 Jan. 12, 2006

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/700,431, filed on Nov. 4, 2003.

(51) **Int. Cl.**
G06F 9/44 (2006.01)
G06F 9/46 (2006.01)

(52) **U.S. Cl.** **717/102**; 717/100; 717/105; 705/8

(58) **Field of Classification Search** .... None
See application file for complete search history.

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"Estimation of project buffers in critical chain project management", Shou et al., Aug. 2002, pp. 162-167, <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=917313>.*

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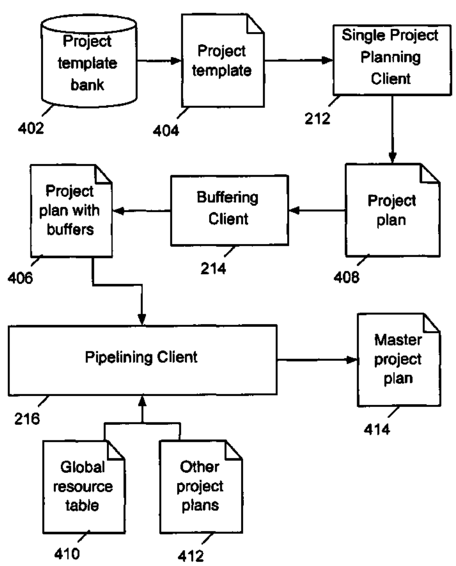
Primary Examiner — Thuy Dao
(74) *Attorney, Agent, or Firm* — Mark Terry

(57) **ABSTRACT**

A method on a computer for providing critical chain-based project management is disclosed. The method includes generating a list of sequential time periods for a project comprising a plurality of tasks and calculating a number of tasks for each time period. The method further includes generating a graphic that visually indicates the number of tasks for each time period and a priority of each task and providing the graphic to a user.

24 Claims, 30 Drawing Sheets



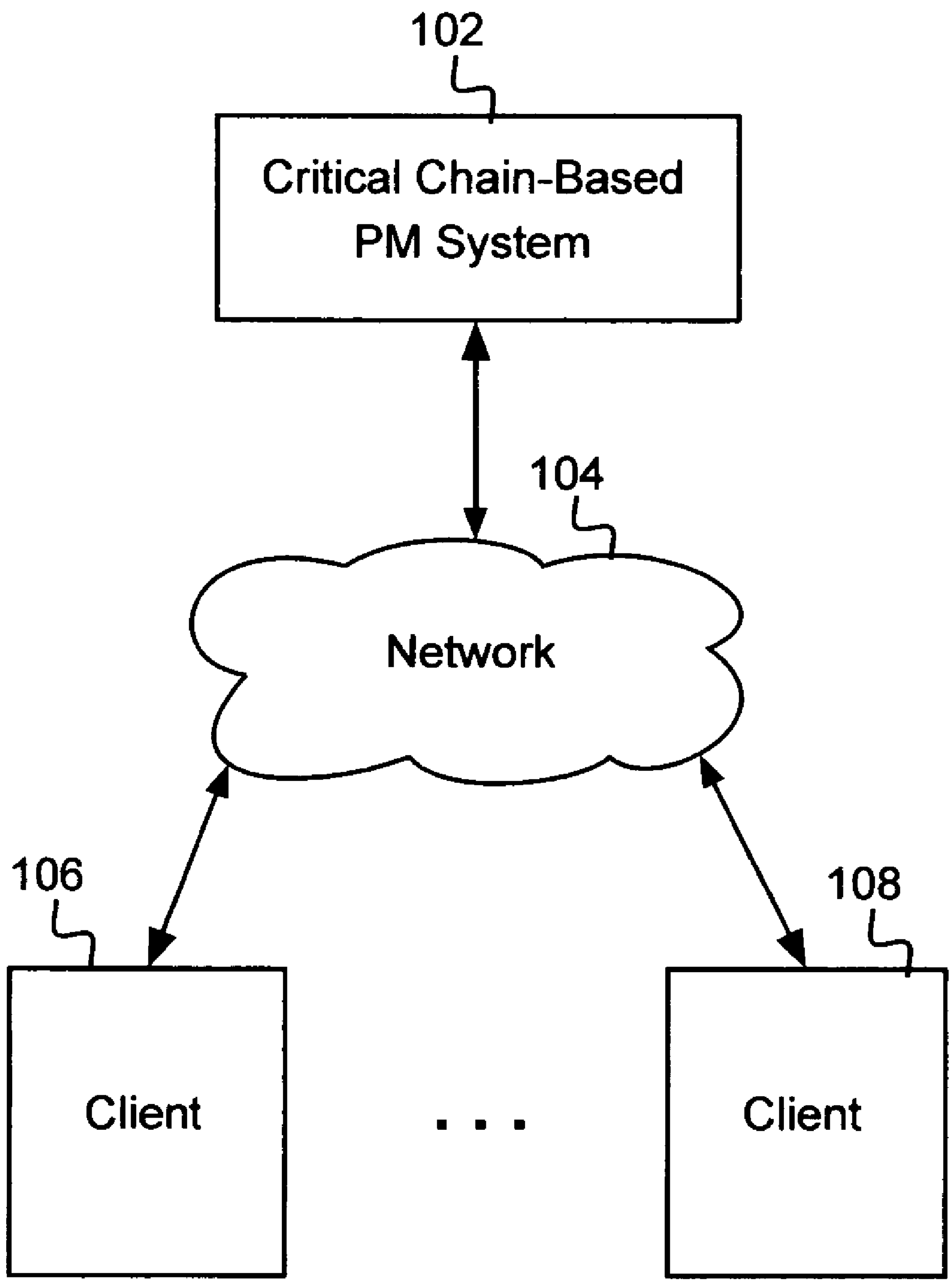

102
Critical Chain-Based
PM System
104
Network
106
108
Client
. . .
Client

FIG. 1

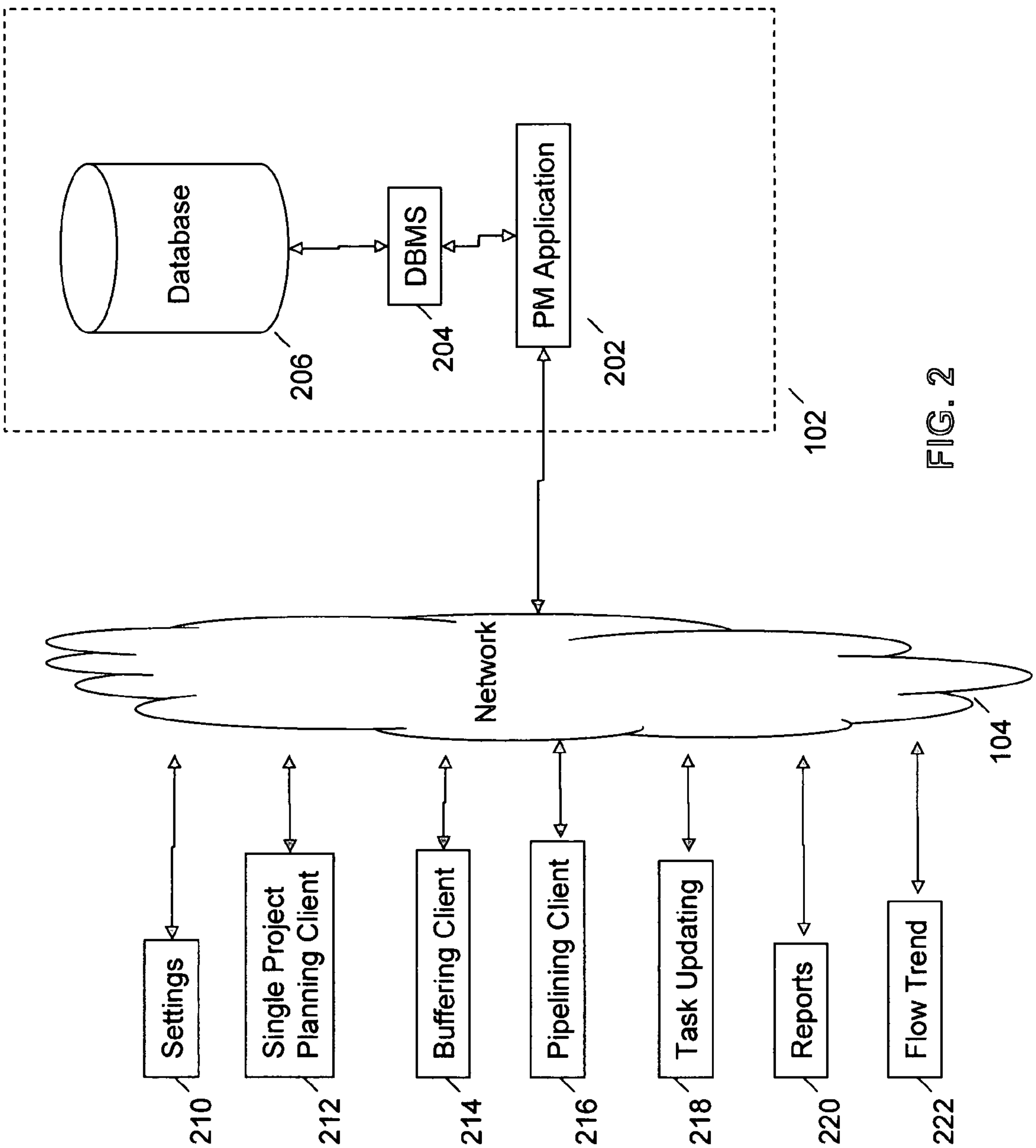

Database
206
DBMS
204
PM Application
202
102
Network
104
Settings
210
Single Project Planning Client
212
Buffering Client
214
Pipelining Client
216
Task Updating
218
Reports
220
Flow Trend
222

FIG. 2

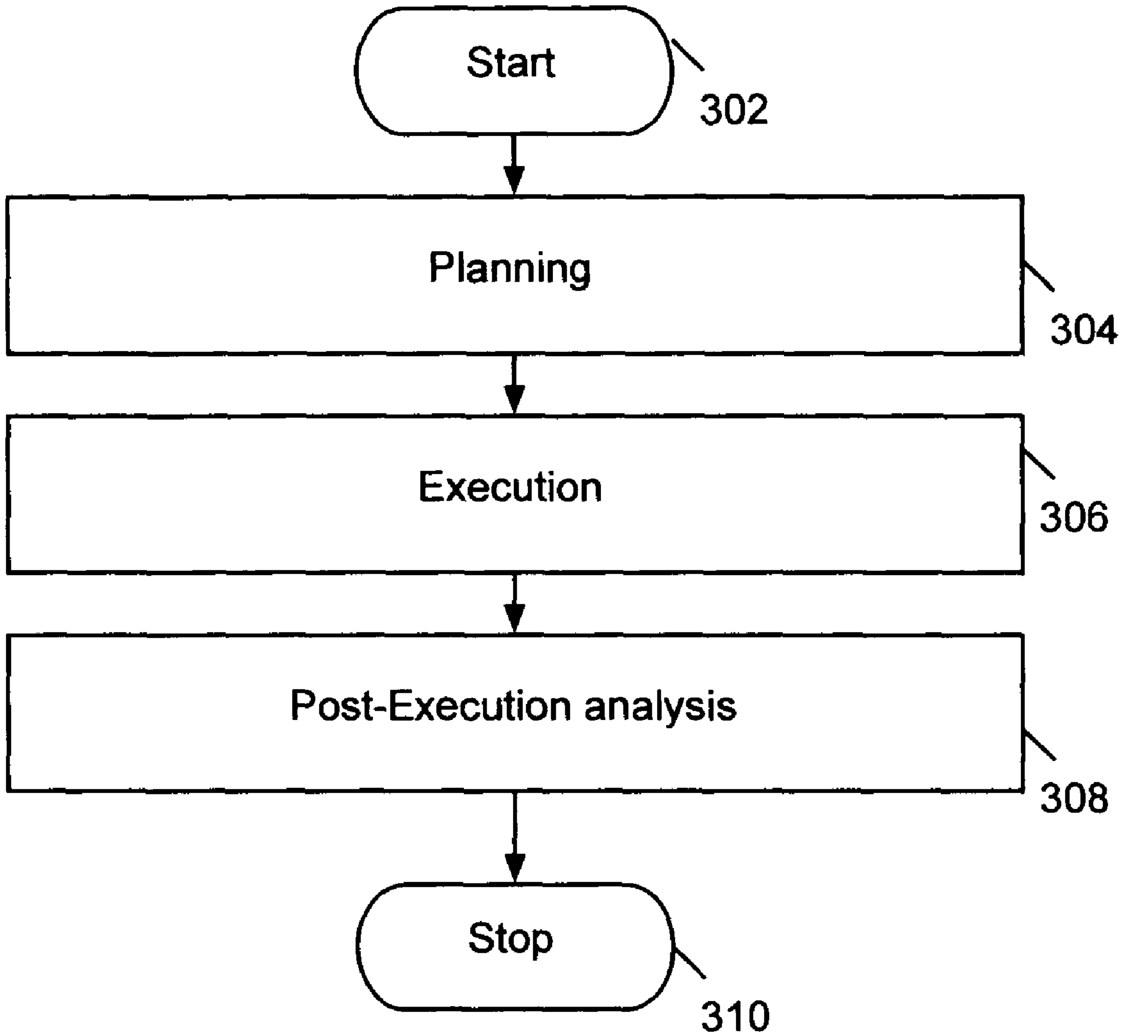

Start
302
Planning
304
Execution
306
Post-Execution analysis
308
Stop
310

FIG. 3

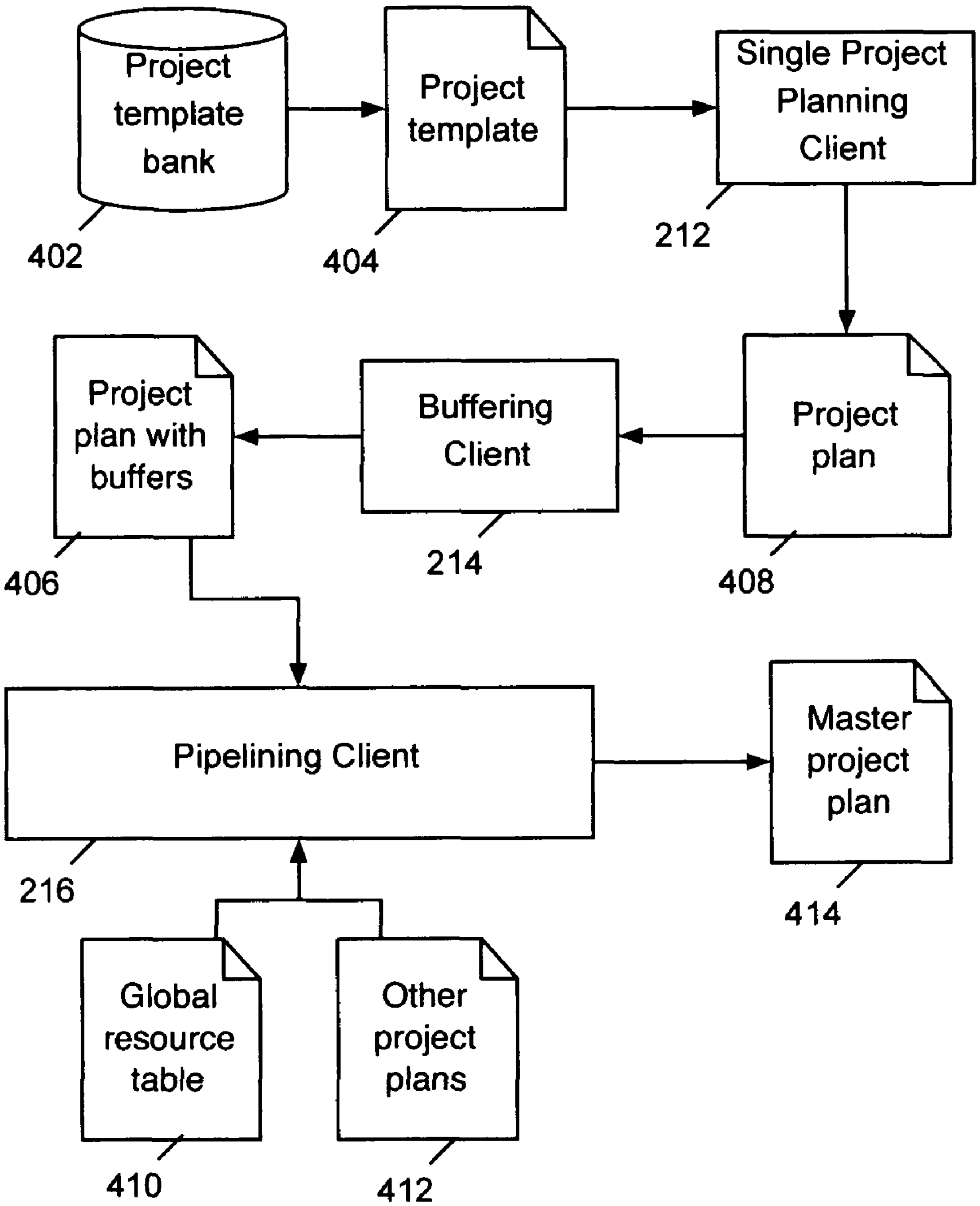

Project template bank
402
Project template
404
Single Project Planning Client
212
Project plan with buffers
406
Buffering Client
214
Project plan
408
Pipelining Client
216
Master project plan
414
Global resource table
410
Other project plans
412

FIG. 4

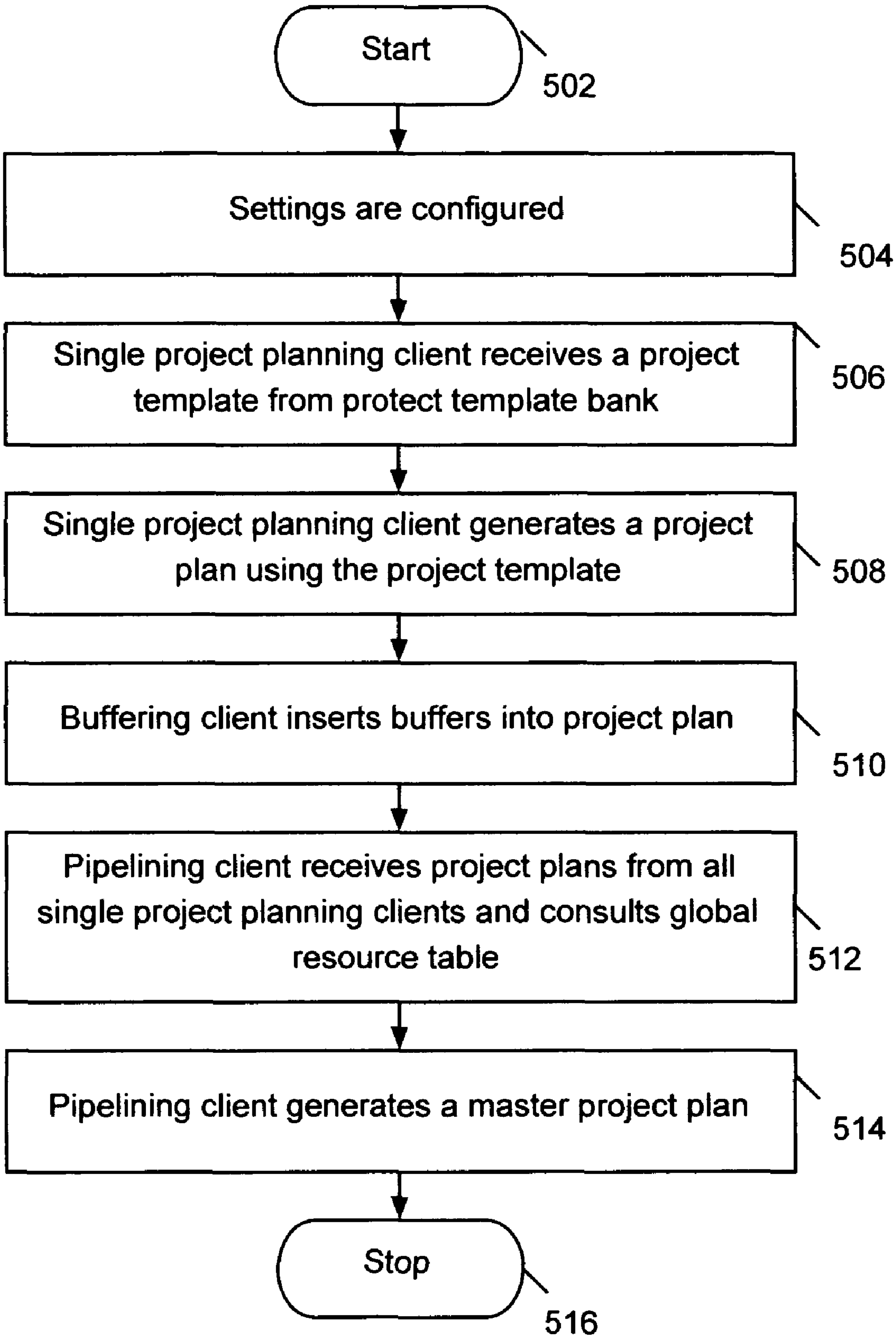

Start
502
Settings are configured
504
Single project planning client receives a project template from protect template bank
506
Single project planning client generates a project plan using the project template
508
Buffering client inserts buffers into project plan
510
Pipelining client receives project plans from all single project planning clients and consults global resource table
512
Pipelining client generates a master project plan
514
Stop
516

FIG. 5

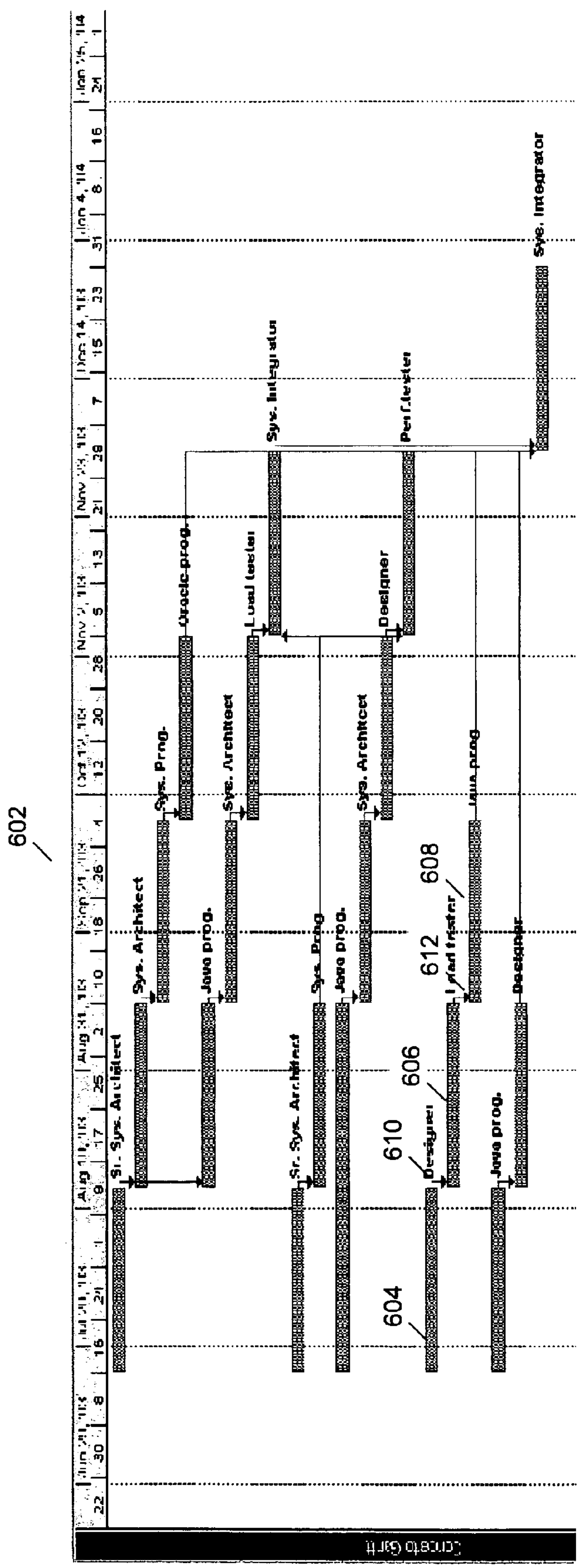


FIG. 6

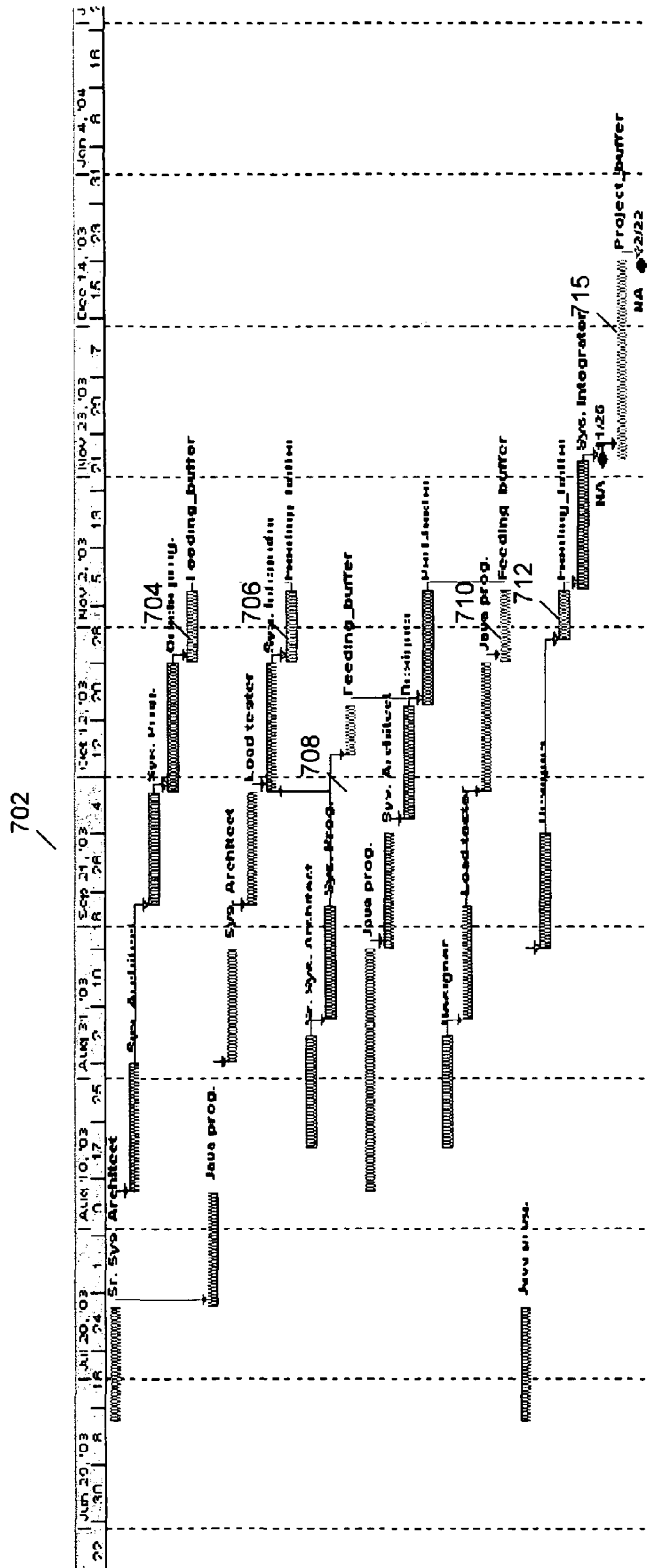


FIG. 7

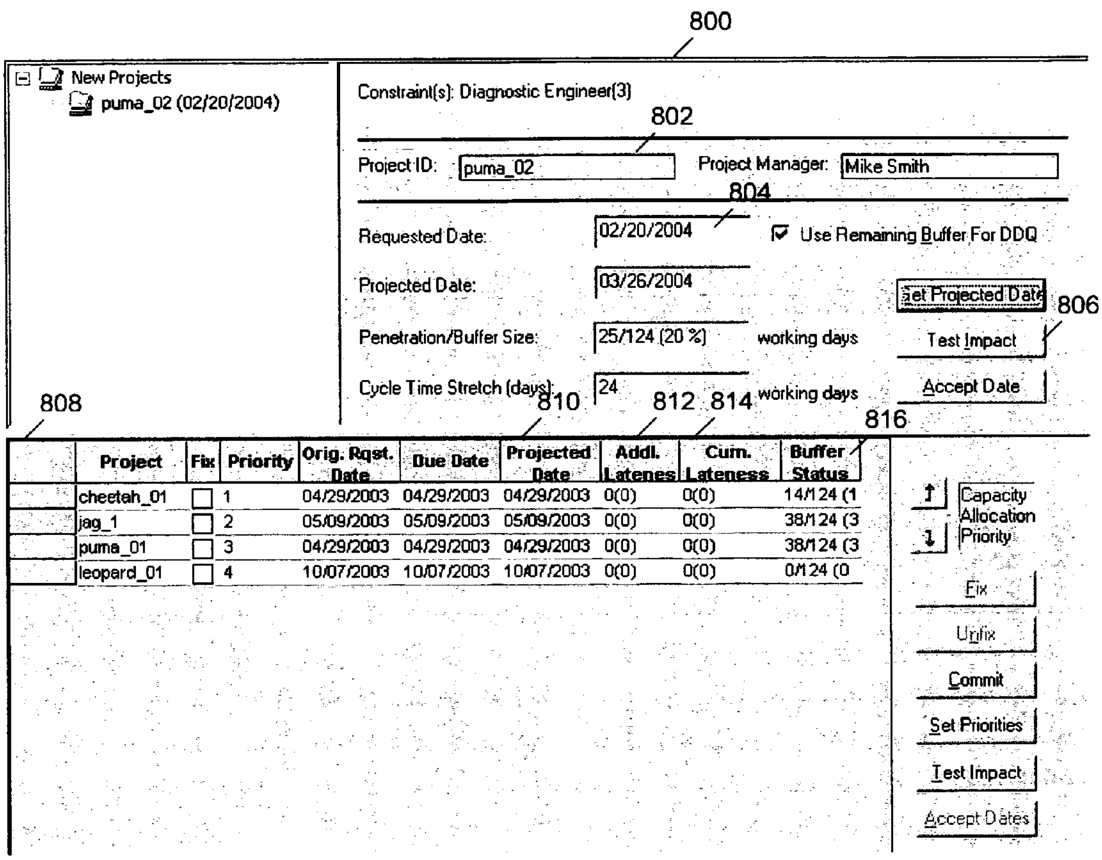
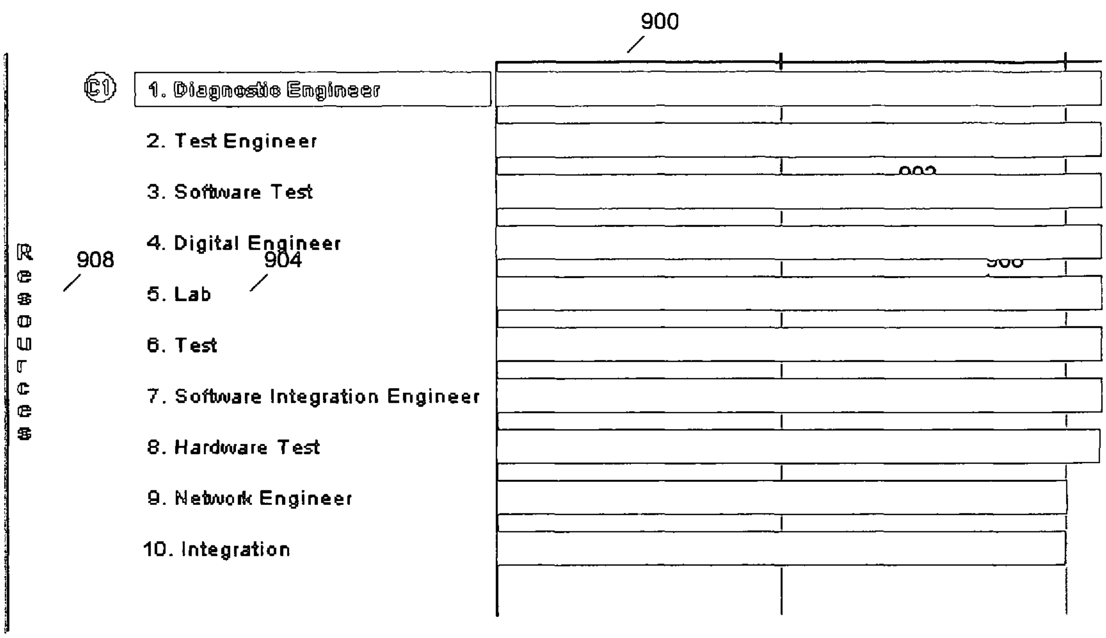

800
New Projects
puma_02 (02/20/2004)
Constraint(s): Diagnostic Engineer(3)
802
Project ID: puma_02
Project Manager: Mike Smith
804
Requested Date: 02/20/2004
Use Remaining Buffer For DDQ
Projected Date: 03/26/2004
Set Projected Date
806
Penetration/Buffer Size: 25/124 (20 %) working days
Test Impact
Cycle Time Stretch (days): 24 working days
Accept Date
808
810
812
814
816
Project | Fix | Priority | Orig. Rqst. Date | Due Date | Projected Date | Addl. Lateness | Cum. Lateness | Buffer Status
cheetah_01 | 1 | 04/29/2003 | 04/29/2003 | 04/29/2003 | 0(0) | 0(0) | 14/124 (1
jag_1 | 2 | 05/09/2003 | 05/09/2003 | 05/09/2003 | 0(0) | 0(0) | 38/124 (3
puma_01 | 3 | 04/29/2003 | 04/29/2003 | 04/29/2003 | 0(0) | 0(0) | 38/124 (3
leopard_01 | 4 | 10/07/2003 | 10/07/2003 | 10/07/2003 | 0(0) | 0(0) | 0/124 (0
Capacity Allocation Priority
Fix
Unfix
Commit
Set Priorities
Test Impact
Accept Dates

FIG. 8



Project	Project Manager
cheetah_01	Matti Herzberg
puma_01	Matti Herzberg
jag_1	Michael Smith
puma_02	Mike Smith
leopard_01	Tom Martin

FIG. 9

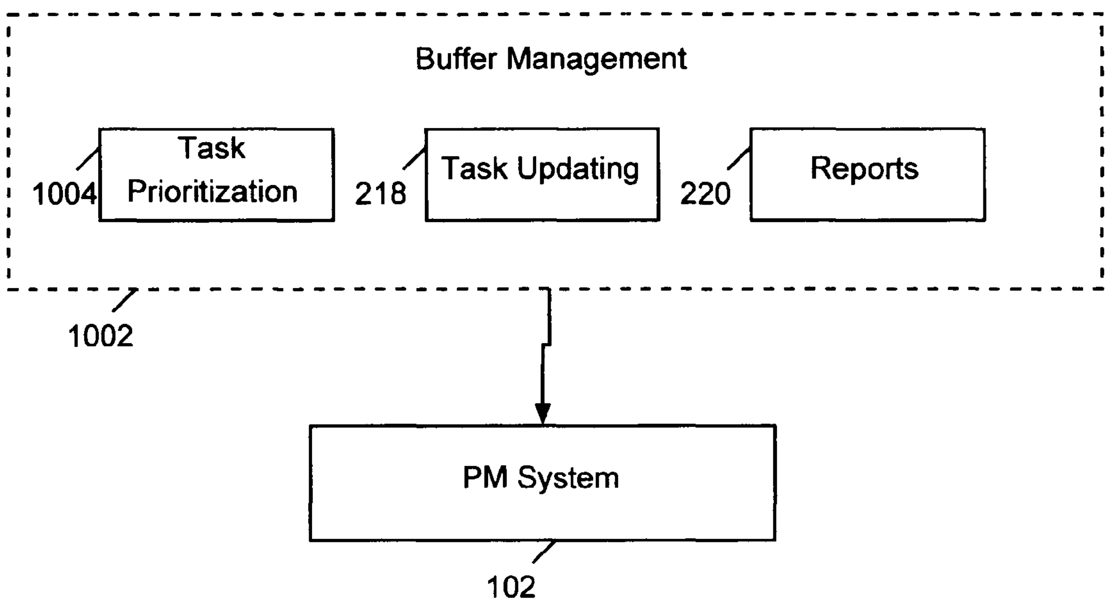

Buffer Management
Task Prioritization
1004
218
Task Updating
220
Reports
1002
PM System
102

FIG. 10

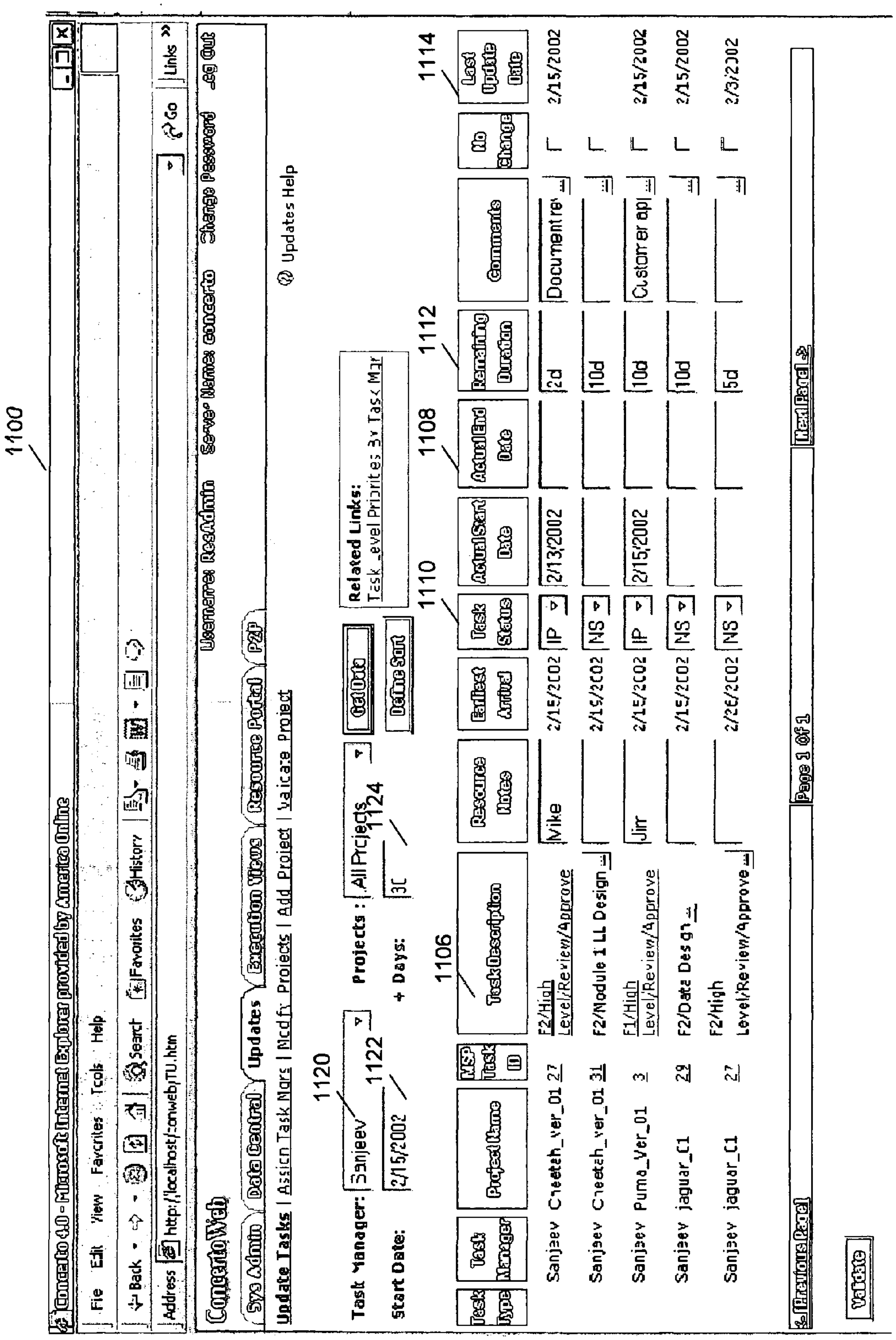

1100
Concerto 4.0 - Microsoft Internet Explorer provided by America Online
File Edit View Favorites Tools Help
Back Search Favorites History
Address http://localhost/conweb/TU.htm
Go Links
ConcertoWeb
Username: ResAdmin Server Name: concerto Change Password Log Out
Sys Admin Data Central Updates Execution Views Resource Portal P2P
Update Tasks | Assign Task Mgrs | Modify Projects | Add Project | Vaicare Project
Updates Help
Task Manager: Sanjeev
Start Date: 2/15/2002
Projects: All Projects
+ Days: 30
Get Data
Define Sort
Related Links:
Task Level Priorities By Task Mgr
1120
1122
1124
1106
1110
1108
1112
1114
Task Type
Task Manager
Project Name
MSP Task ID
Task Description
Resource Notes
Earliest Arrival
Task Status
Actual Start Date
Actual End Date
Remaining Duration
Comments
No Change
Last Update Date
Sanjeev Cheetah_ver_01 27 F2/High Level/Review/Approve Mike 2/15/2002 IP 2/13/2002 2d Document re 2/15/2002
Sanjeev Cheetah_ver_01 31 F2/Module 1 LL Design 2/15/2002 NS 10d
Sanjeev Puma_Ver_01 3 F1/High Level/Review/Approve Jim 2/15/2002 IP 2/15/2002 10d Customer apl 2/15/2002
Sanjeev jaguar_C1 29 F2/Data Design 2/15/2002 NS 10d 2/15/2002
Sanjeev jaguar_C1 27 F2/High Level/Review/Approve 2/26/2002 NS 5d 2/3/2002
Previous Page
Page 1 of 1
Next Page
Validate

FIG. 11

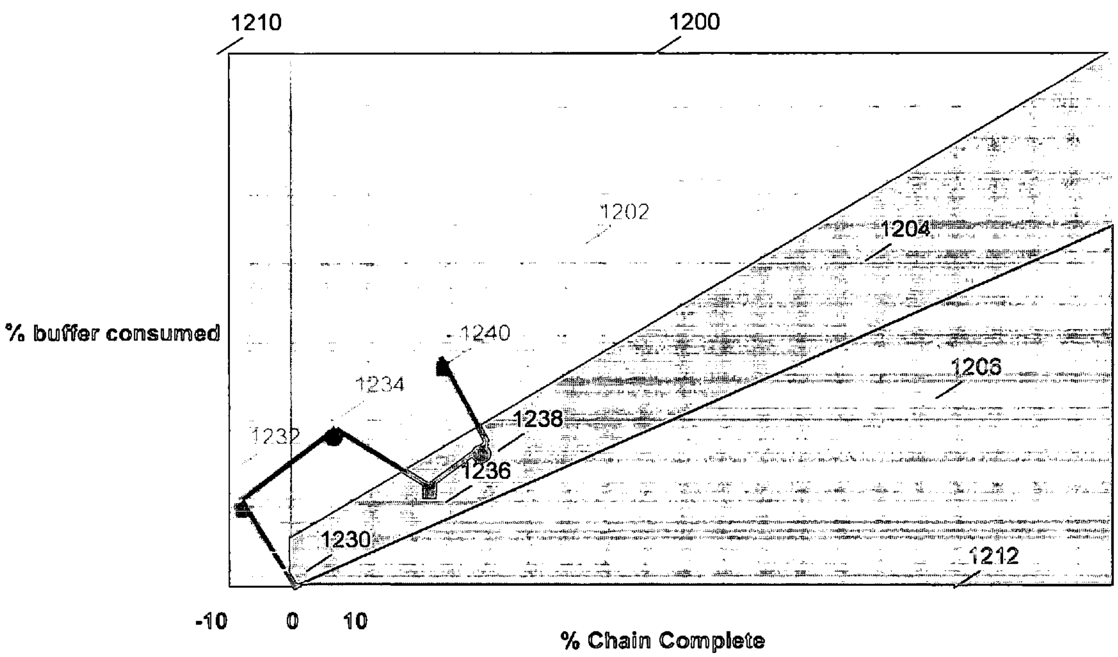

1210
1200
1202
1204
% buffer consumed
1240
1234
1232
1238
1236
1206
1230
1212
-10
0
10
% Chain Complete

FIG. 12

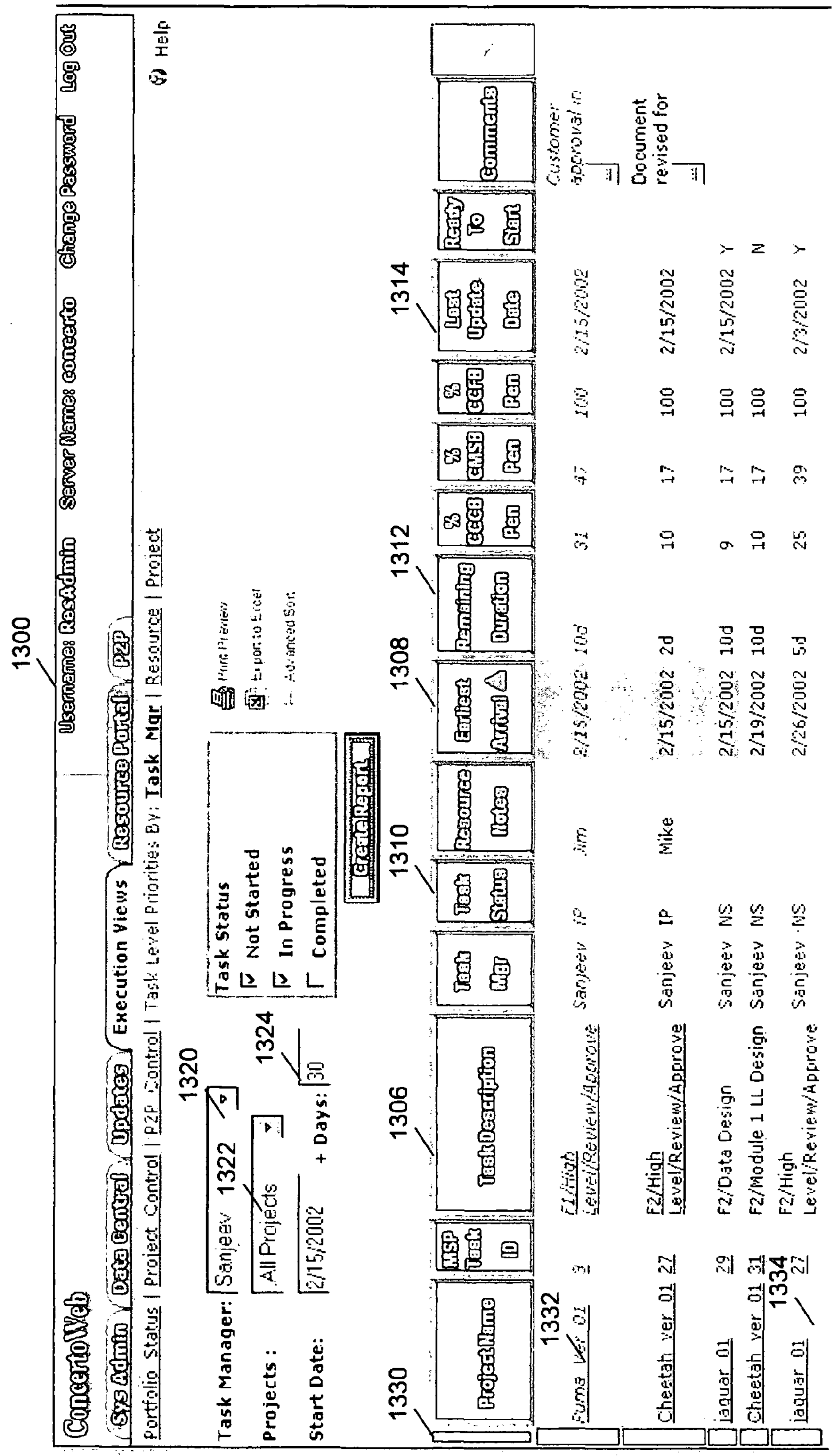

1300
ConcertoWeb
Username: ResAdmin
Server Name: concerto
Change Password
Log Out
Sys Admin
Data Central
Updates
Execution Views
Resource Portal
P2P
Portfolio Status | Project Control | P2P Control | Task Level Priorities By: Task Mgr | Resource | Project
Help
Task Manager: Sanjeev
Projects: All Projects
Start Date: 2/15/2002
+ Days: 30
Task Status
Not Started
In Progress
Completed
Create Report
Print Preview
Export to Excel
Advanced Sort
1320
1322
1324
1330
1306
1310
1308
1312
1314
1332
1334
Project Name
MSP Task ID
Task Description
Task Mgr
Task Status
Resource Notes
Earliest Arrival
Remaining Duration
% CCCB Pen
% CMSB Pen
% CCFB Pen
Last Update Date
Ready To Start
Comments
Puma Ver 01 3 F1/High Level/Review/Approve Sanjeev IP Jim 2/15/2002 10d 31 47 100 2/15/2002 Customer approval in
Cheetah ver 01 27 F2/High Level/Review/Approve Sanjeev IP Mike 2/15/2002 2d 10 17 100 2/15/2002 Document revised for
Jaguar 01 29 F2/Data Design Sanjeev NS 2/15/2002 10d 9 17 100 2/15/2002 Y
Cheetah ver 01 31 F2/Module 1 LL Design Sanjeev NS 2/19/2002 10d 10 17 100 N
Jaguar 01 27 F2/High Level/Review/Approve Sanjeev NS 2/26/2002 5d 25 39 100 2/3/2002 Y

FIG. 13A

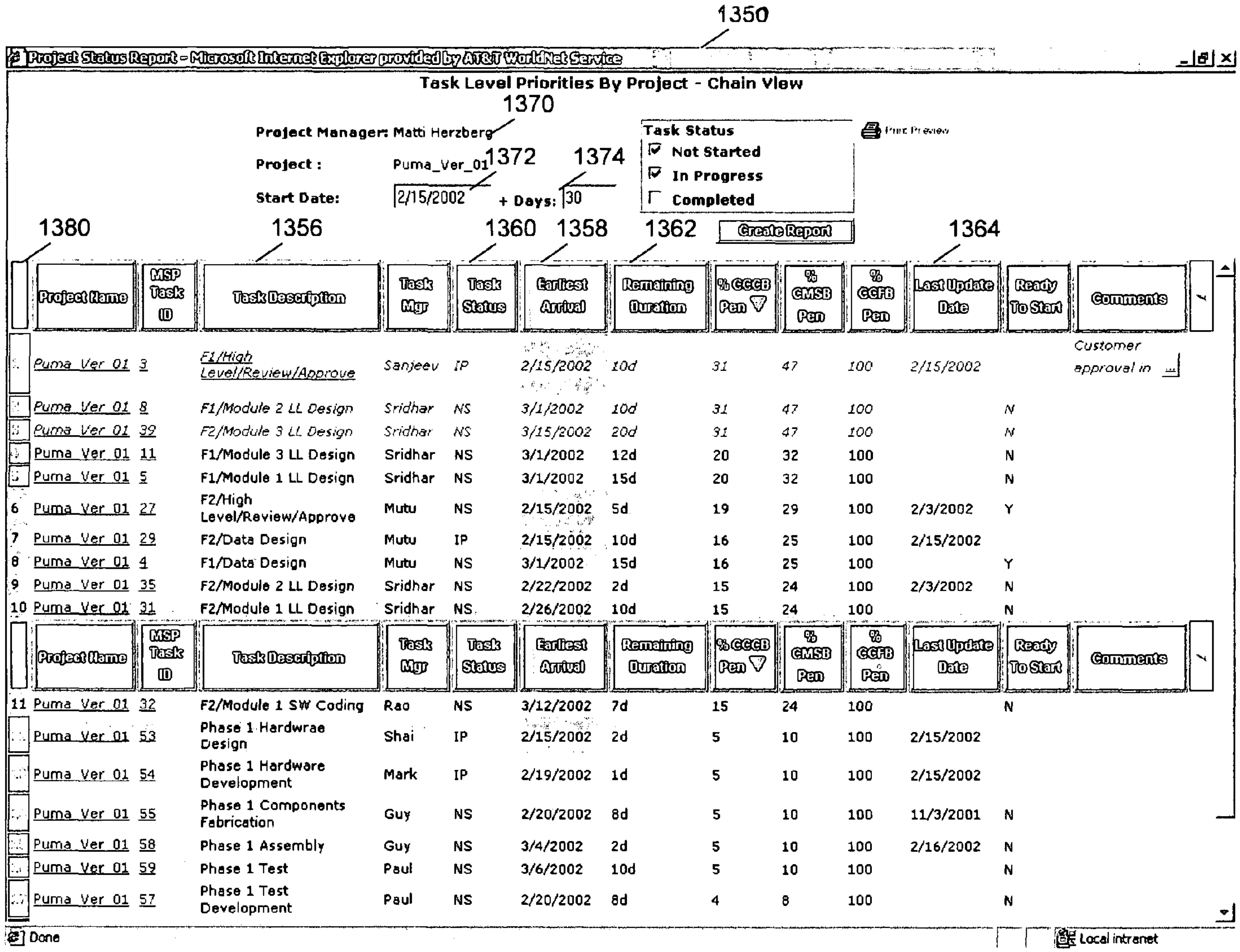

1350
Project Status Report - Microsoft Internet Explorer provided by AT&T WorldNet Service
Task Level Priorities By Project - Chain View
1370
Project Manager: Matti Herzberg
Project : Puma_Ver_01
1372
1374
Start Date: 2/15/2002 + Days: 30
Task Status
Not Started
In Progress
Completed
Print Preview
Create Report
1380
1356
1360
1358
1362
1364
Project Name | MSP Task ID | Task Description | Task Mgr | Task Status | Earliest Arrival | Remaining Duration | % CCCB Pen | % CMSB Pen | % CCFB Pen | Last Update Date | Ready To Start | Comments
Puma_Ver_01 3 F1/High Level/Review/Approve Sanjeev IP 2/15/2002 10d 31 47 100 2/15/2002 Customer approval in
Puma_Ver_01 8 F1/Module 2 LL Design Sridhar NS 3/1/2002 10d 31 47 100 N
Puma_Ver_01 39 F2/Module 3 LL Design Sridhar NS 3/15/2002 20d 31 47 100 N
Puma_Ver_01 11 F1/Module 3 LL Design Sridhar NS 3/1/2002 12d 20 32 100 N
Puma_Ver_01 5 F1/Module 1 LL Design Sridhar NS 3/1/2002 15d 20 32 100 N
6 Puma_Ver_01 27 F2/High Level/Review/Approve Mutu NS 2/15/2002 5d 19 29 100 2/3/2002 Y
7 Puma_Ver_01 29 F2/Data Design Mutu IP 2/15/2002 10d 16 25 100 2/15/2002
8 Puma_Ver_01 4 F1/Data Design Mutu NS 3/1/2002 15d 16 25 100 Y
9 Puma_Ver_01 35 F2/Module 2 LL Design Sridhar NS 2/22/2002 2d 15 24 100 2/3/2002 N
10 Puma_Ver_01 31 F2/Module 1 LL Design Sridhar NS 2/26/2002 10d 15 24 100 N
Project Name | MSP Task ID | Task Description | Task Mgr | Task Status | Earliest Arrival | Remaining Duration | % CCCB Pen | % CMSB Pen | % CCFB Pen | Last Update Date | Ready To Start | Comments
11 Puma_Ver_01 32 F2/Module 1 SW Coding Rao NS 3/12/2002 7d 15 24 100 N
Puma_Ver_01 53 Phase 1 Hardwrae Design Shai IP 2/15/2002 2d 5 10 100 2/15/2002
Puma_Ver_01 54 Phase 1 Hardware Development Mark IP 2/19/2002 1d 5 10 100 2/15/2002
Puma_Ver_01 55 Phase 1 Components Fabrication Guy NS 2/20/2002 8d 5 10 100 11/3/2001 N
Puma_Ver_01 58 Phase 1 Assembly Guy NS 3/4/2002 2d 5 10 100 2/16/2002 N
Puma_Ver_01 59 Phase 1 Test Paul NS 3/6/2002 10d 5 10 100 N
Puma_Ver_01 57 Phase 1 Test Development Paul NS 2/20/2002 8d 4 8 100 N
Done
Local intranet

FIG. 13B

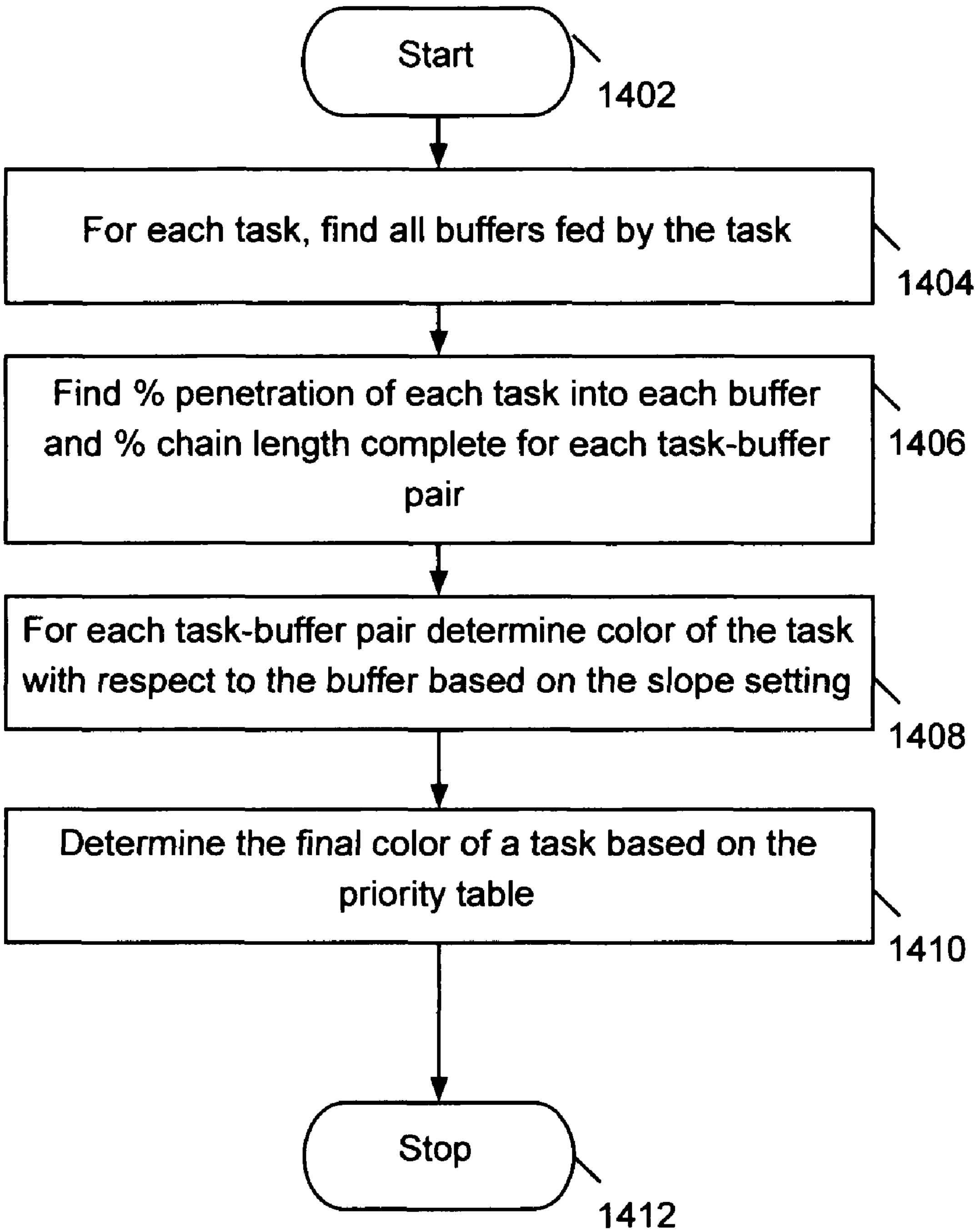

Start
1402
For each task, find all buffers fed by the task
1404
Find % penetration of each task into each buffer and % chain length complete for each task-buffer pair
1406
For each task-buffer pair determine color of the task with respect to the buffer based on the slope setting
1408
Determine the final color of a task based on the priority table
1410
Stop
1412

FIG. 14

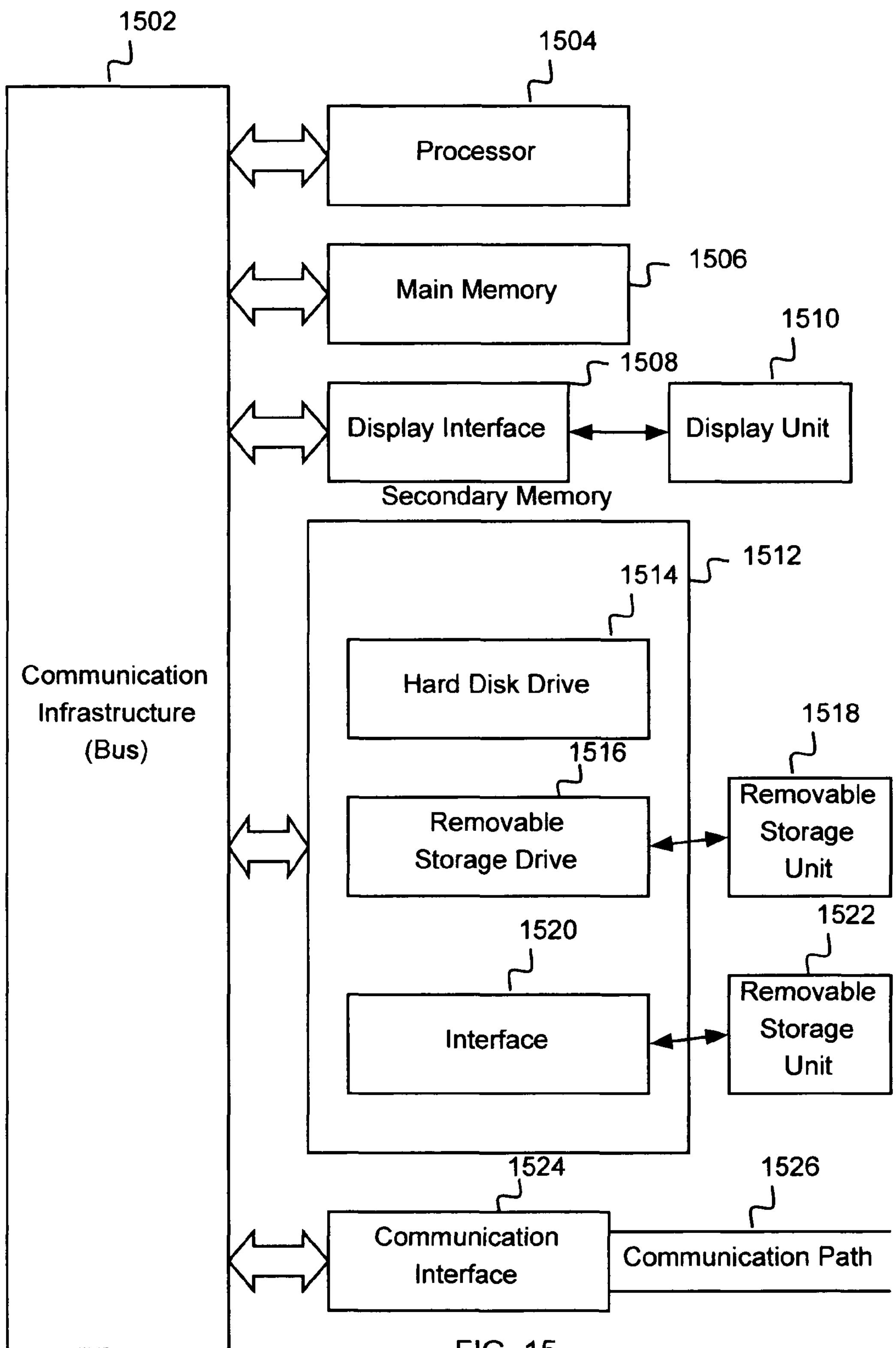
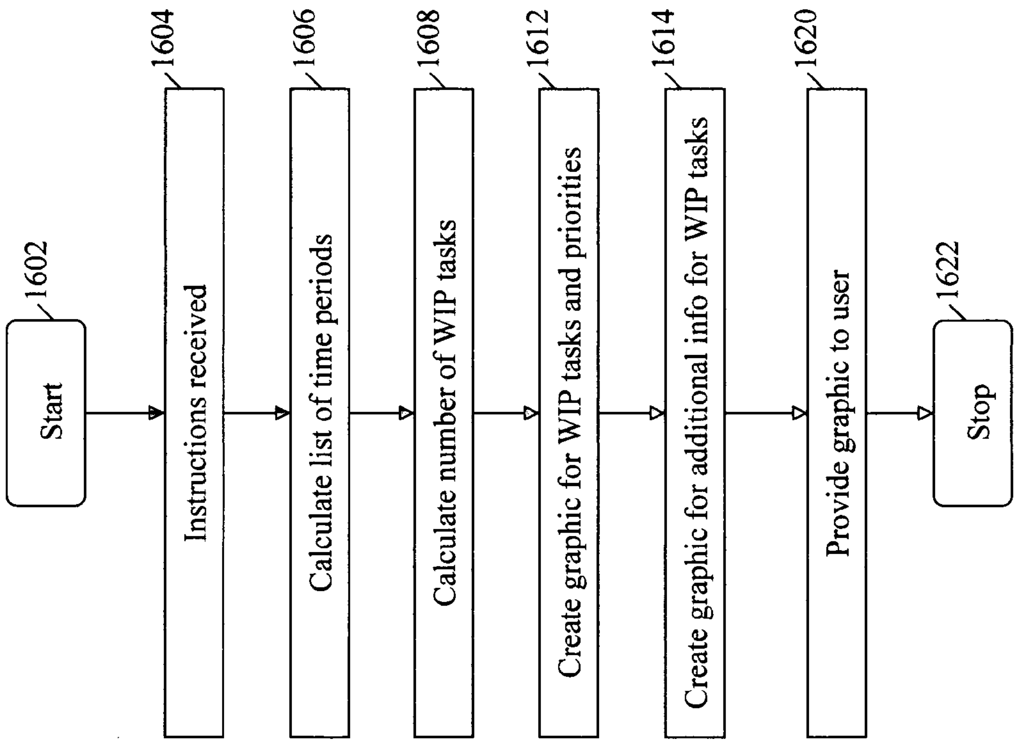

1502
1504
Processor
Main Memory
1506
1510
1508
Display Interface
Display Unit
Secondary Memory
1512
1514
Communication
Infrastructure
(Bus)
Hard Disk Drive
1518
1516
Removable
Storage Drive
Removable
Storage
Unit
1522
1520
Interface
Removable
Storage
Unit
1524
1526
Communication
Interface
Communication Path

FIG. 15



1602
Start
1604
Instructions received
1606
Calculate list of time periods
1608
Calculate number of WIP tasks
1612
Create graphic for WIP tasks and priorities
1614
Create graphic for additional info for WIP tasks
1620
Provide graphic to user
1622
Stop

FIG. 16

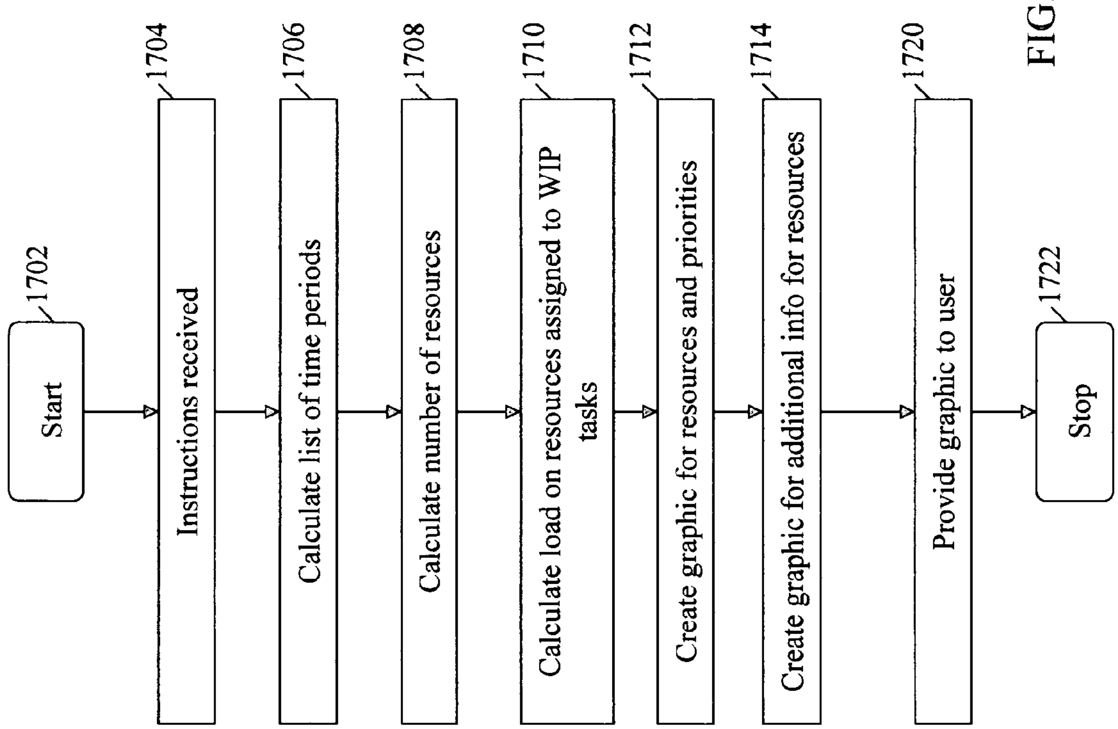

1702
Start
1704
Instructions received
1706
Calculate list of time periods
1708
Calculate number of resources
1710
Calculate load on resources assigned to WIP tasks
1712
Create graphic for resources and priorities
1714
Create graphic for additional info for resources
1720
Provide graphic to user
1722
Stop

FIG. 17

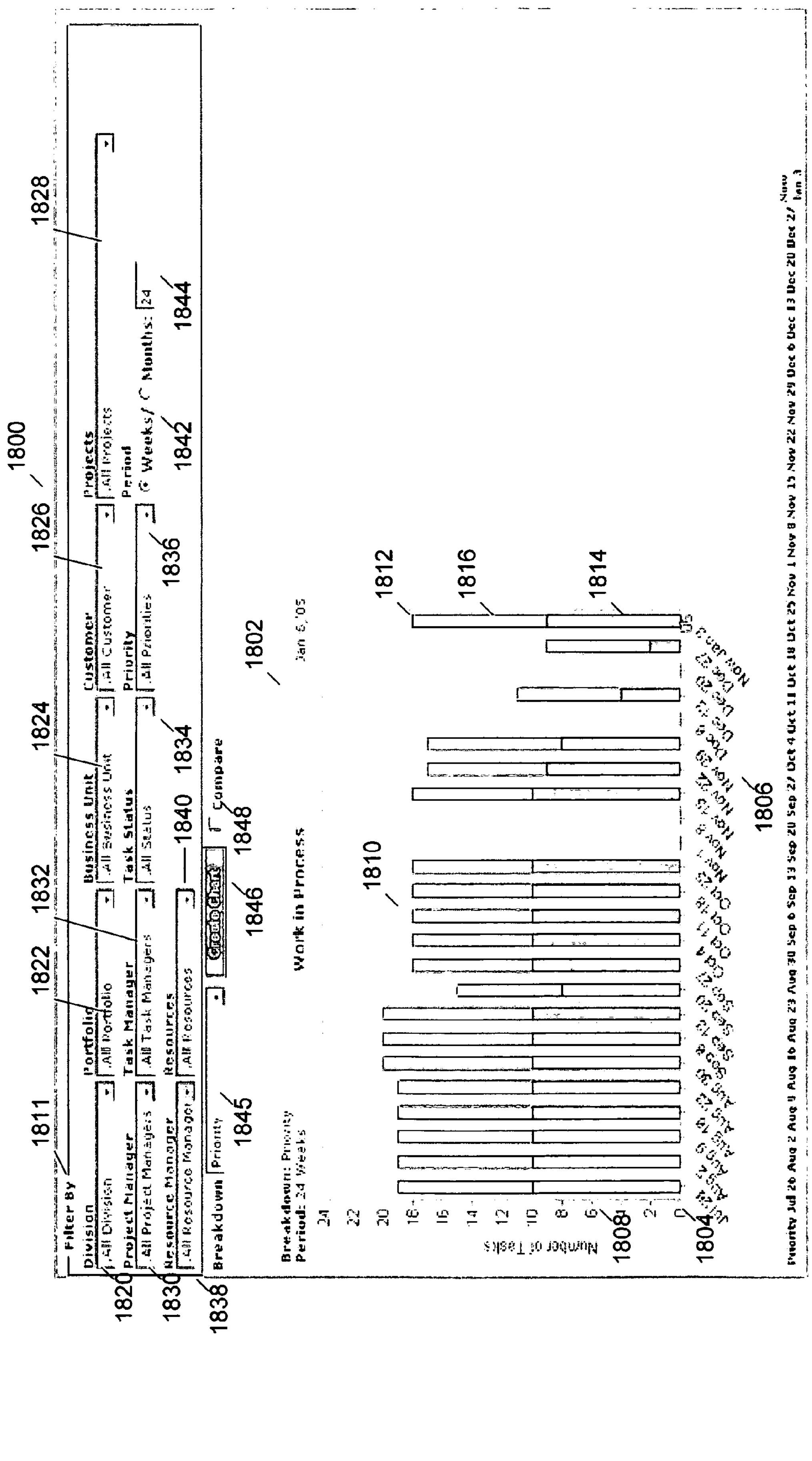

1800
1811
Filter By
Division
All Division
Portfolio
All Portfolio
Business Unit
All Business Unit
Customer
All Customer
Projects
All Projects
Project Manager
All Project Managers
Task Manager
All Task Managers
Task Status
All Status
Priority
All Priorities
Period
Weeks/ Months: 24
Resource Manager
All Resource Manager
Resources
All Resources
Breakdown
Priority
Create Chart
Compare
Work in Process
Breakdown: Priority
Period: 24 Weeks
Number of Tasks
Jan 6, '05
1802
1804
1806
1808
1810
1812
1814
1816
1820
1822
1824
1826
1828
1830
1832
1834
1836
1838
1840
1842
1844
1845
1846
1848

FIG. 18

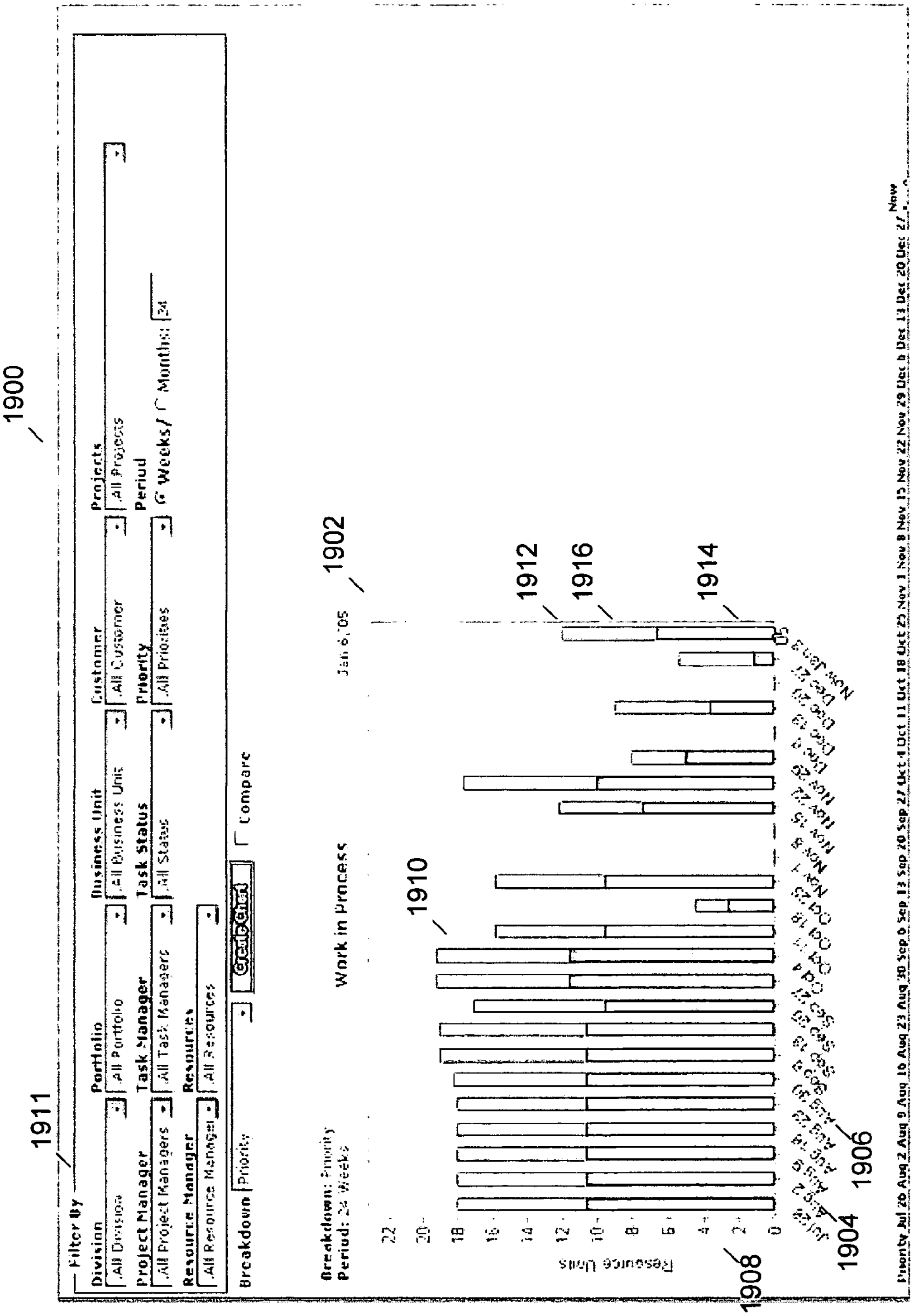

1900
1911
1902
1910
1912
1916
1914
1904
1906
1908
Filter By
Division
Portfolio
Business Unit
Customer
Projects
Project Manager
Task Manager
Task Status
Priority
Period
Resource Manager
Resources
Breakdown
Compare
Work in Process
Resource Units

FIG. 19

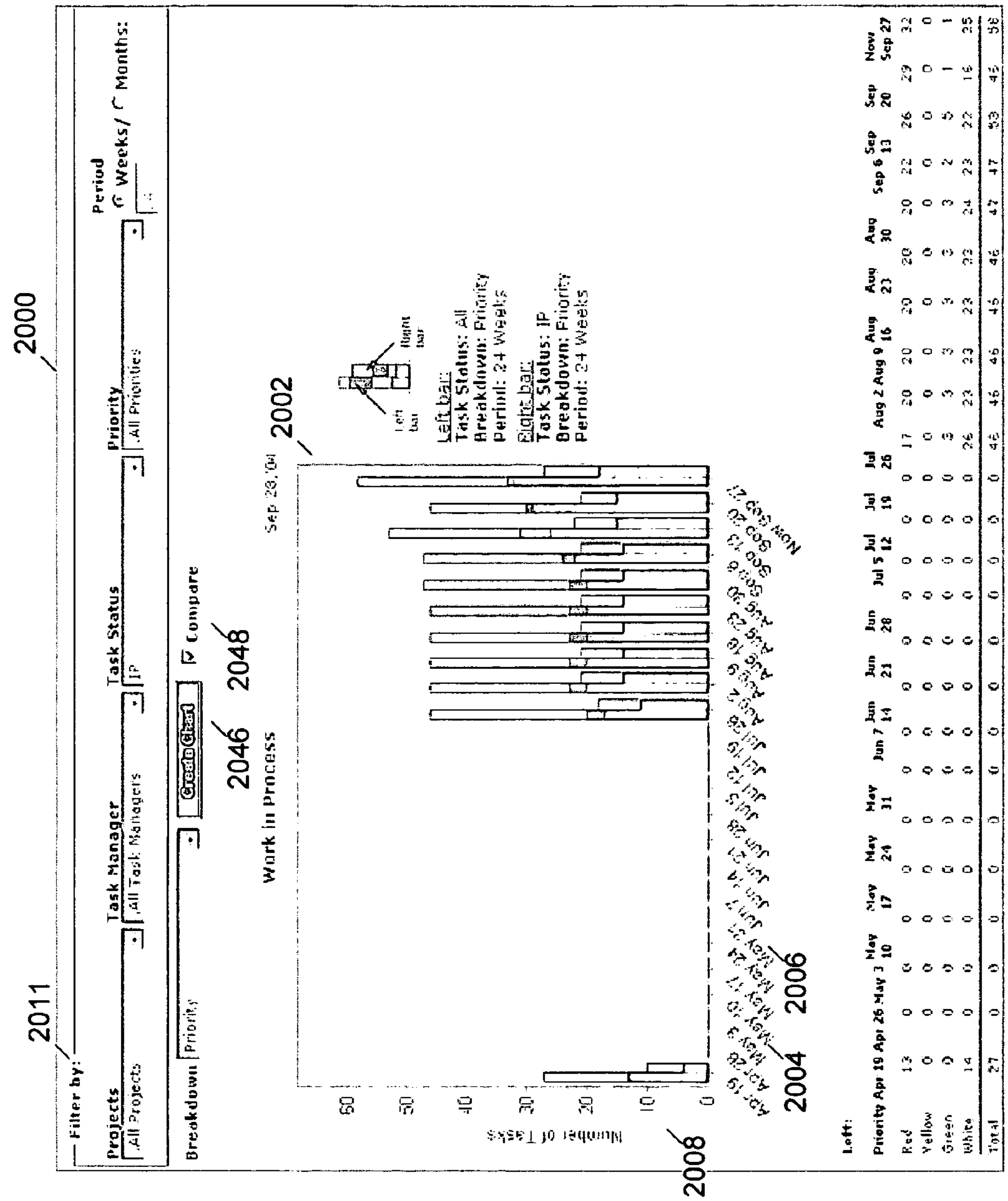

2000
2011
Filter by:
Projects
All Projects
Task Manager
All Task Managers
Task Status
IP
Priority
All Priorities
Period
Weeks/
Months:
Breakdown
Priority
Create Chart
2046
Compare
2048
Work in Process
Sep 28, '04
2002
Number of Tasks
2008
2004
2006
Left bar
Task Status: All
Breakdown: Priority
Period: 24 Weeks
Right bar
Task Status: IP
Breakdown: Priority
Period: 24 Weeks
Left:
Priority
Red
Yellow
Green
White
Total

FIG. 20

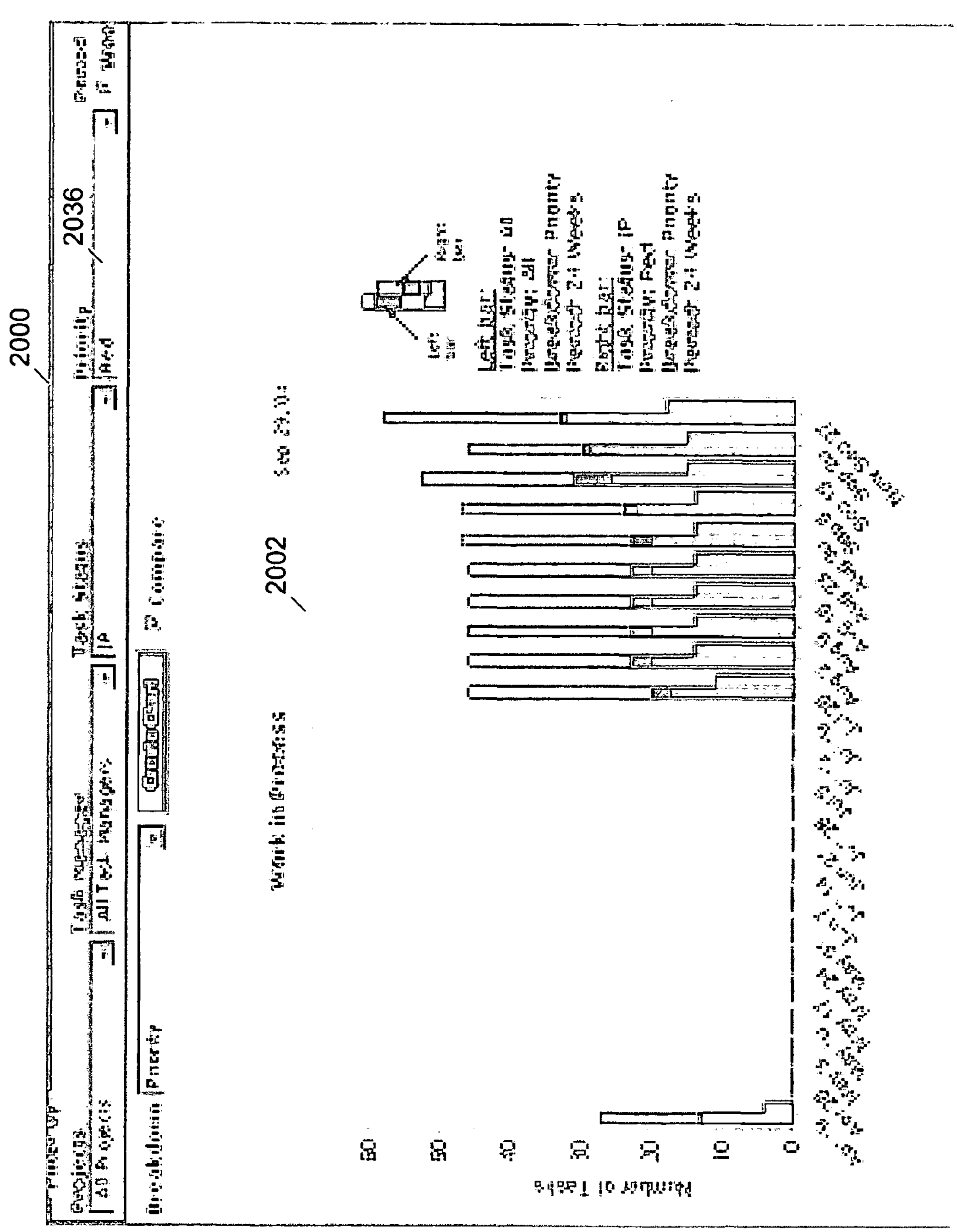


FIG. 21

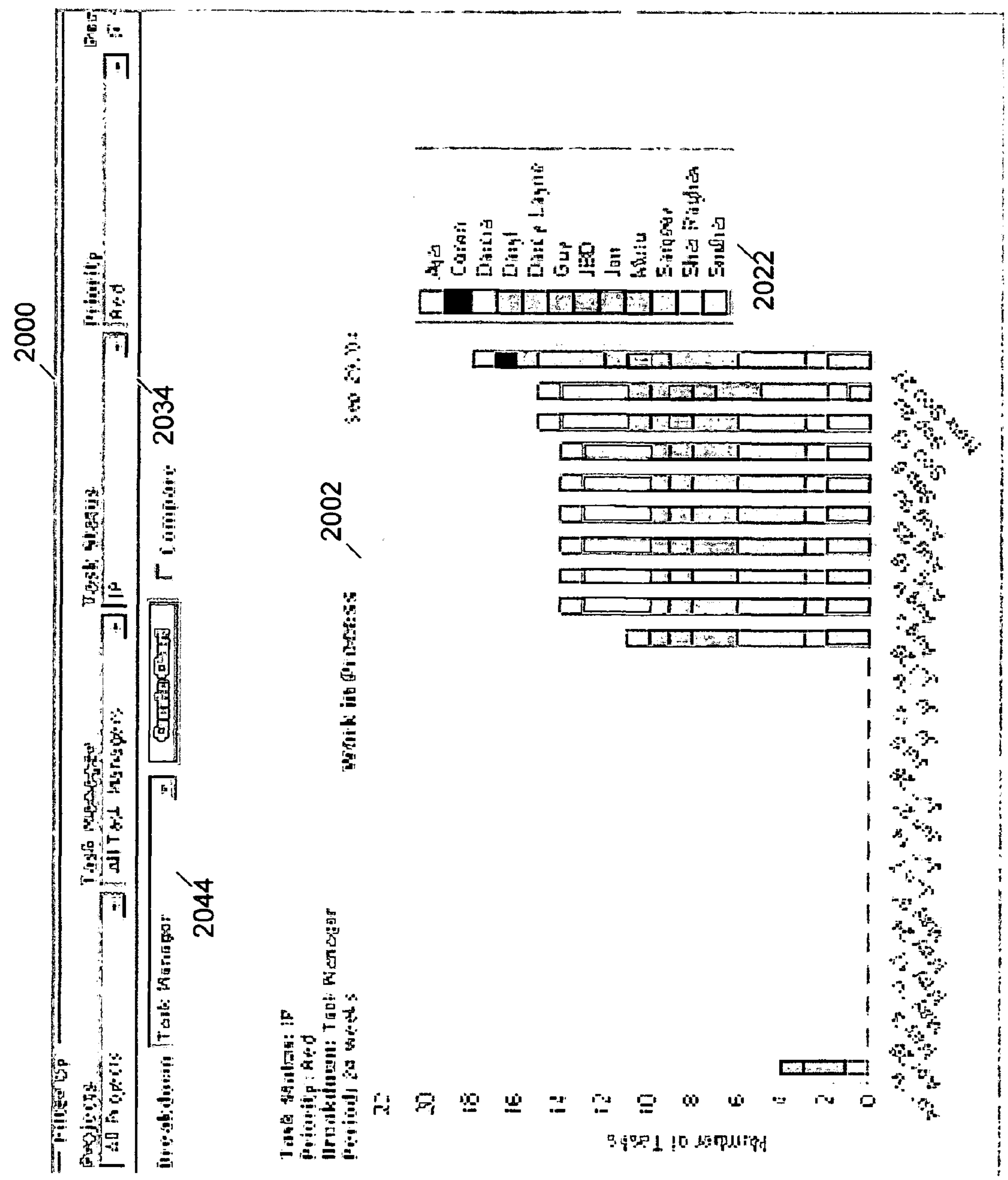

2000
2034
2002
2044
2022
Work in Process
Compare
Task Manager
Number of Tasks

FIG. 22

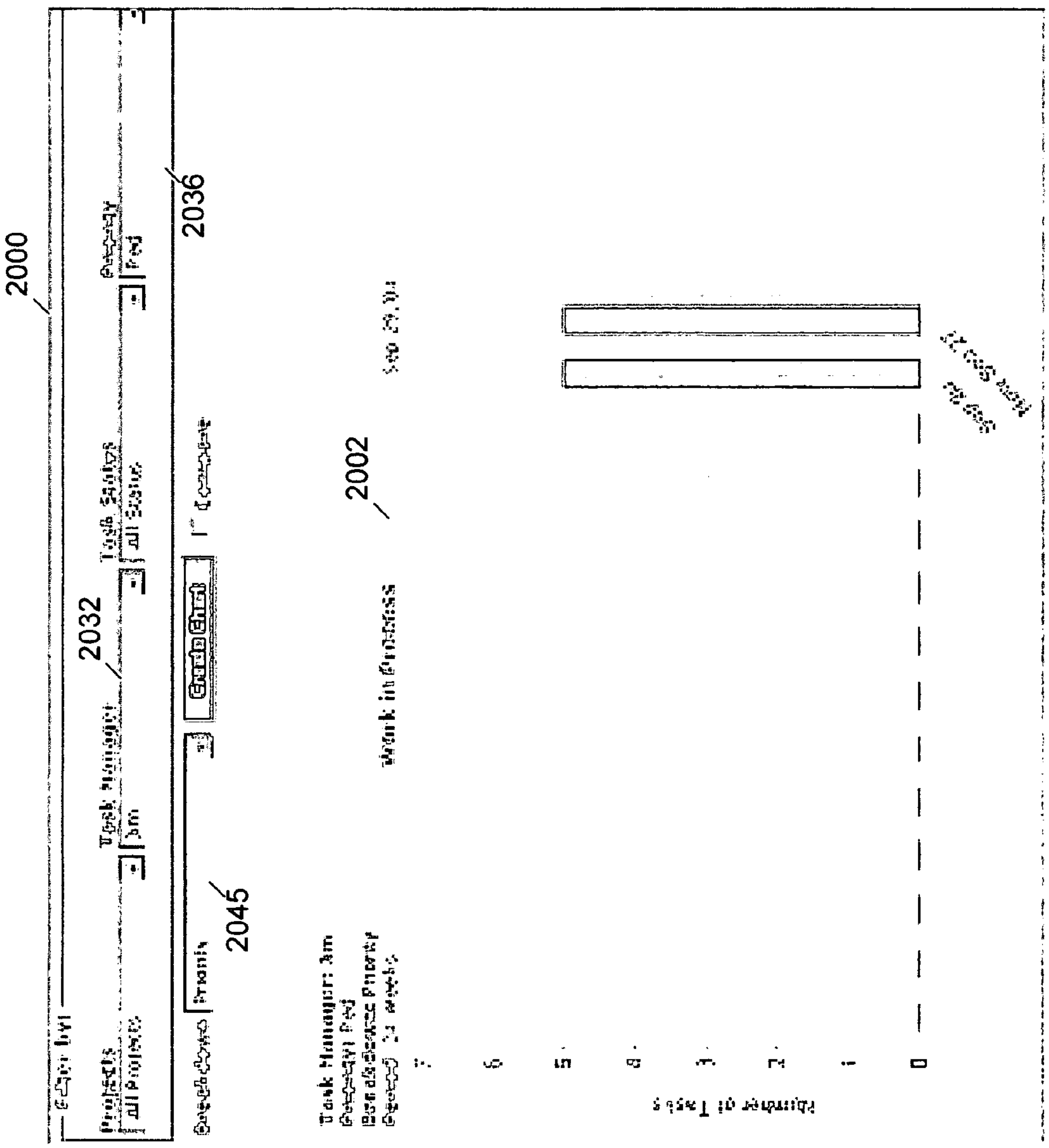


FIG. 23

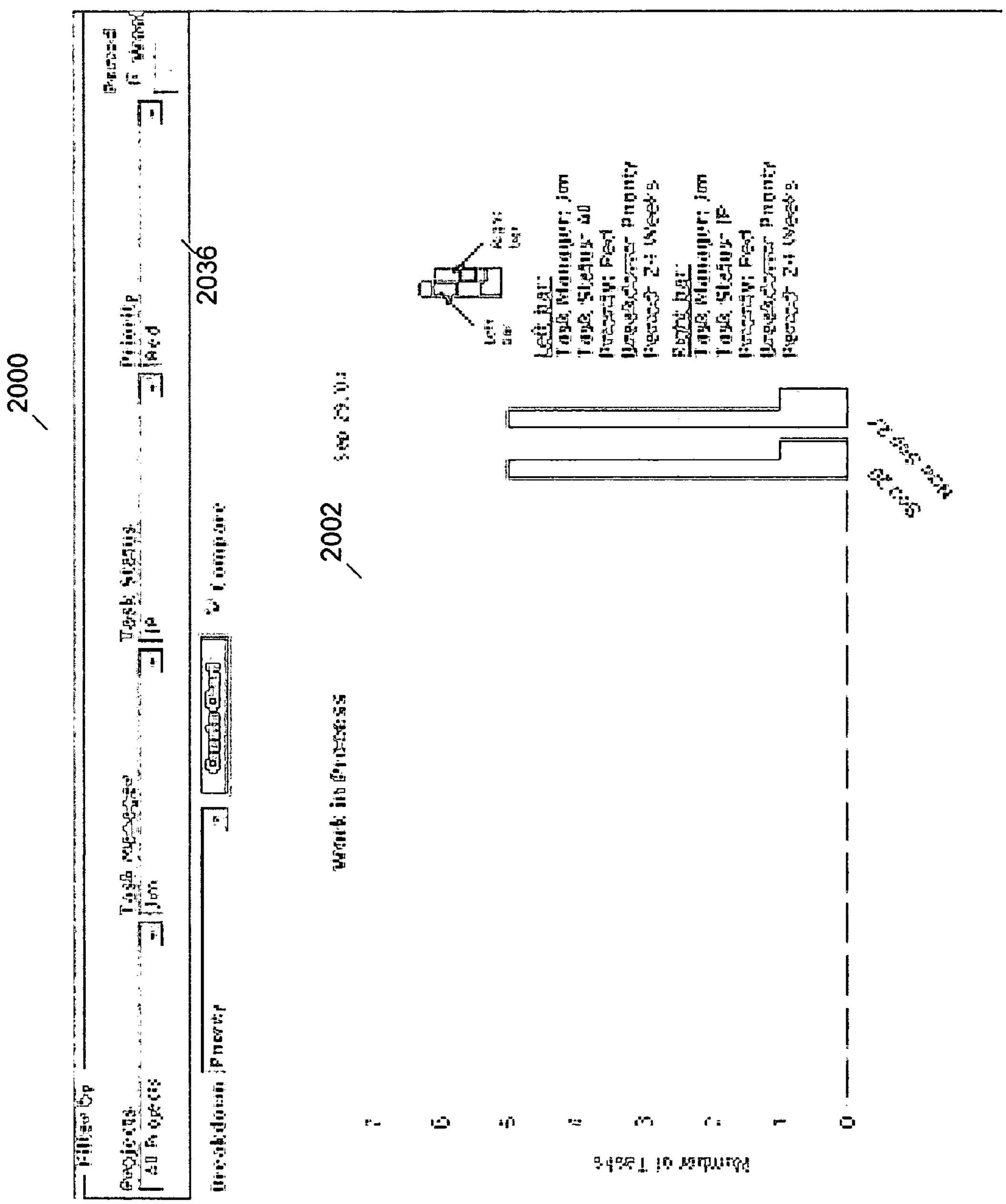

2000
2036
2002
Filter By
Projects
All Projects
Task Manager
Jim
Task Status
IP
Priority
Red
Breakdown
Priority
Compare
Work in Process
Number of Tasks
Left bar
Task Manager: Jim
Task Status: All
Priority: Red
Breakdown: Priority
Period: 24 Weeks
Right bar
Task Manager: Jim
Task Status: IP
Priority: Red
Breakdown: Priority
Period: 24 Weeks

FIG. 24

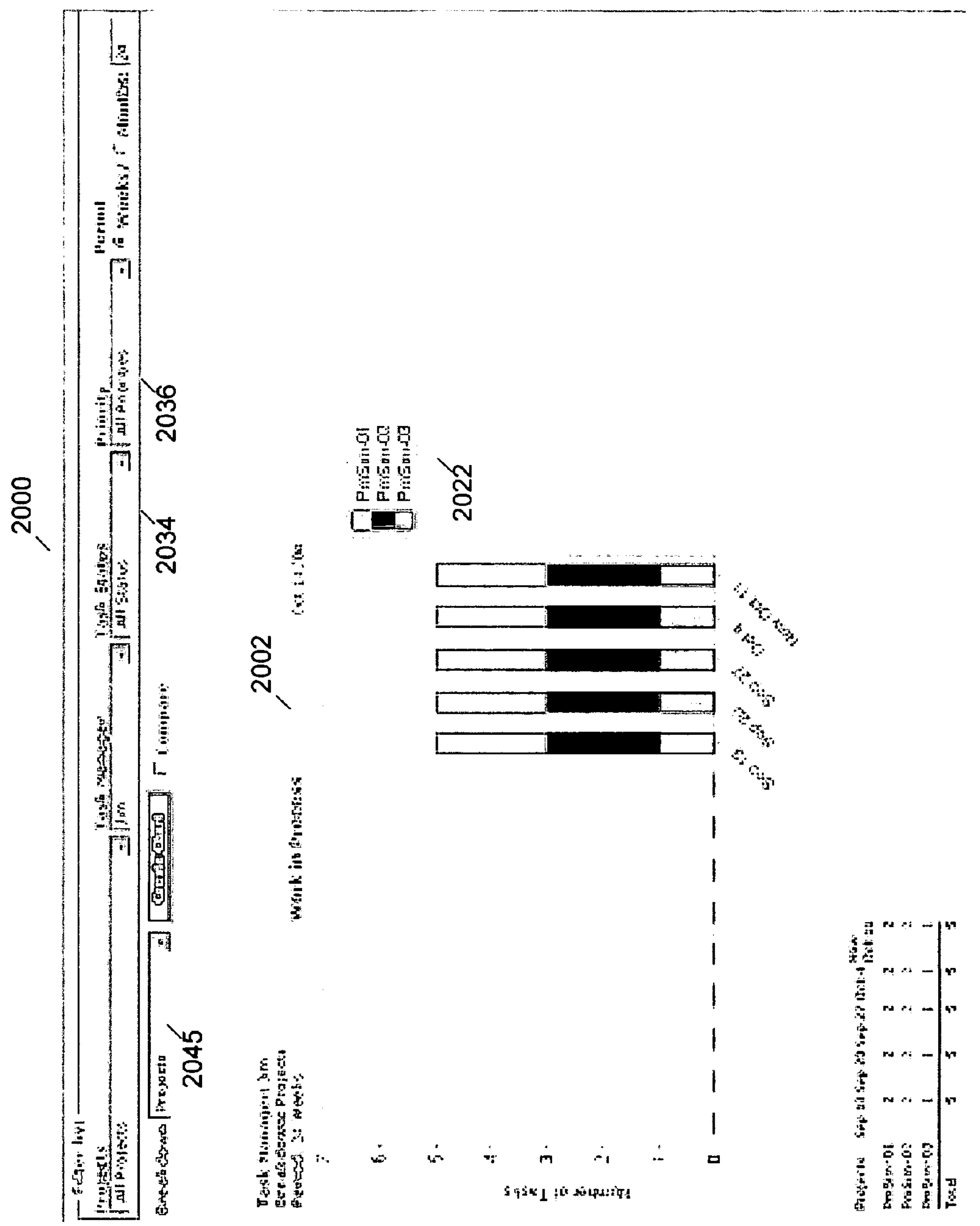

2000
2002
2022
2034
2036
2045
Work in Process
Number of Tasks

FIG. 25

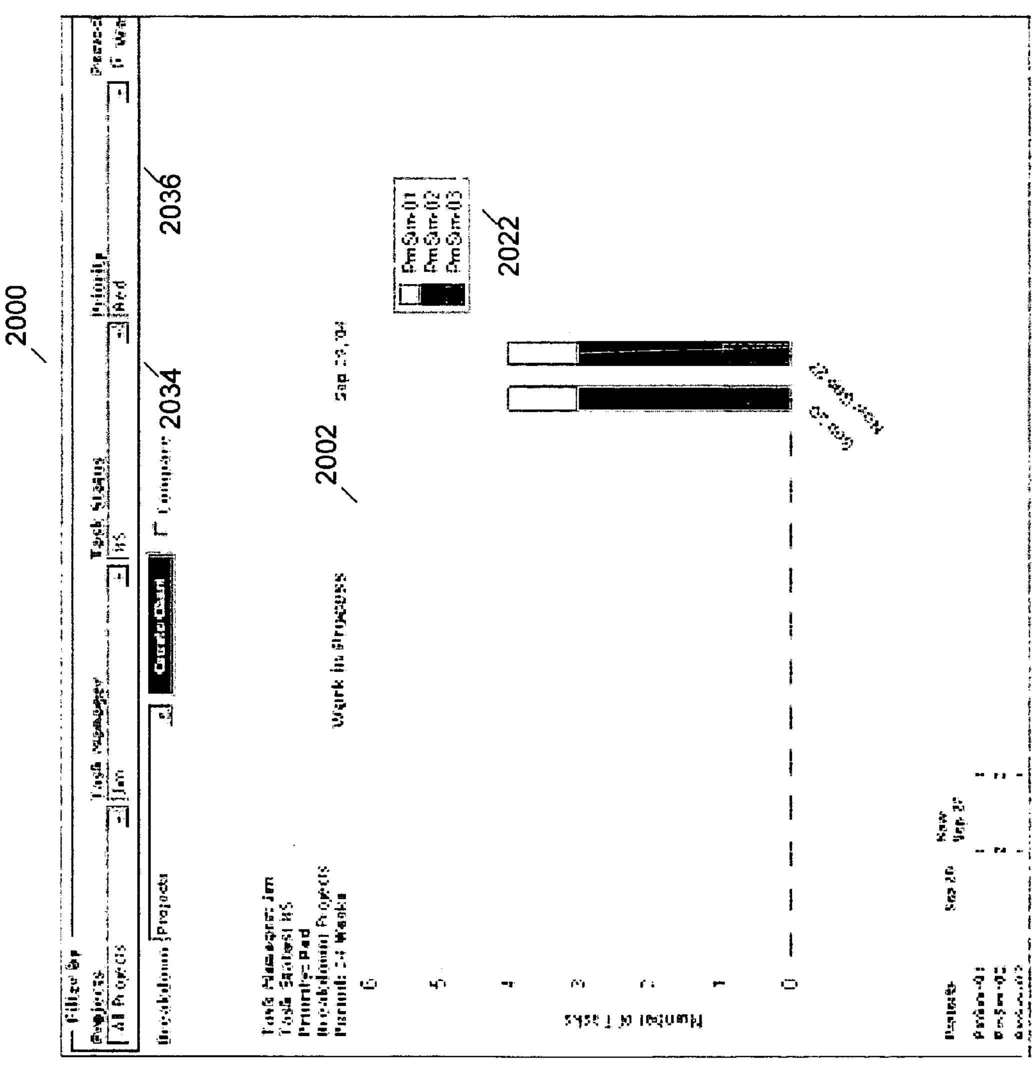

2000
2002
2022
2034
2036
Work in Progress
Number of Tasks
PmSam-01
PmSam-02
PmSam-03

FIG. 26

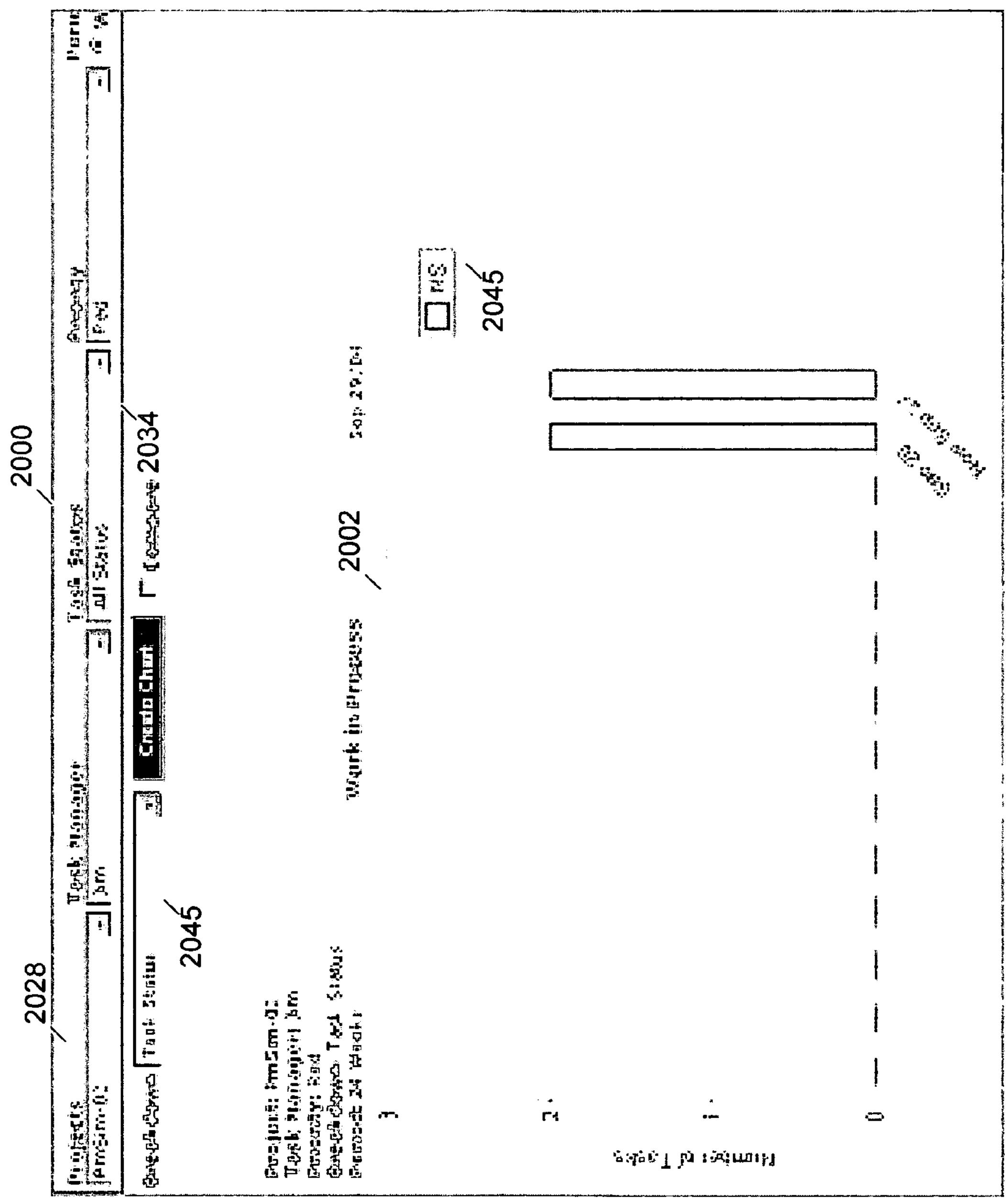

2000
2028
2034
2045
2002
2045
Create Chart
Work in Progress
Number of Tasks

FIG. 27

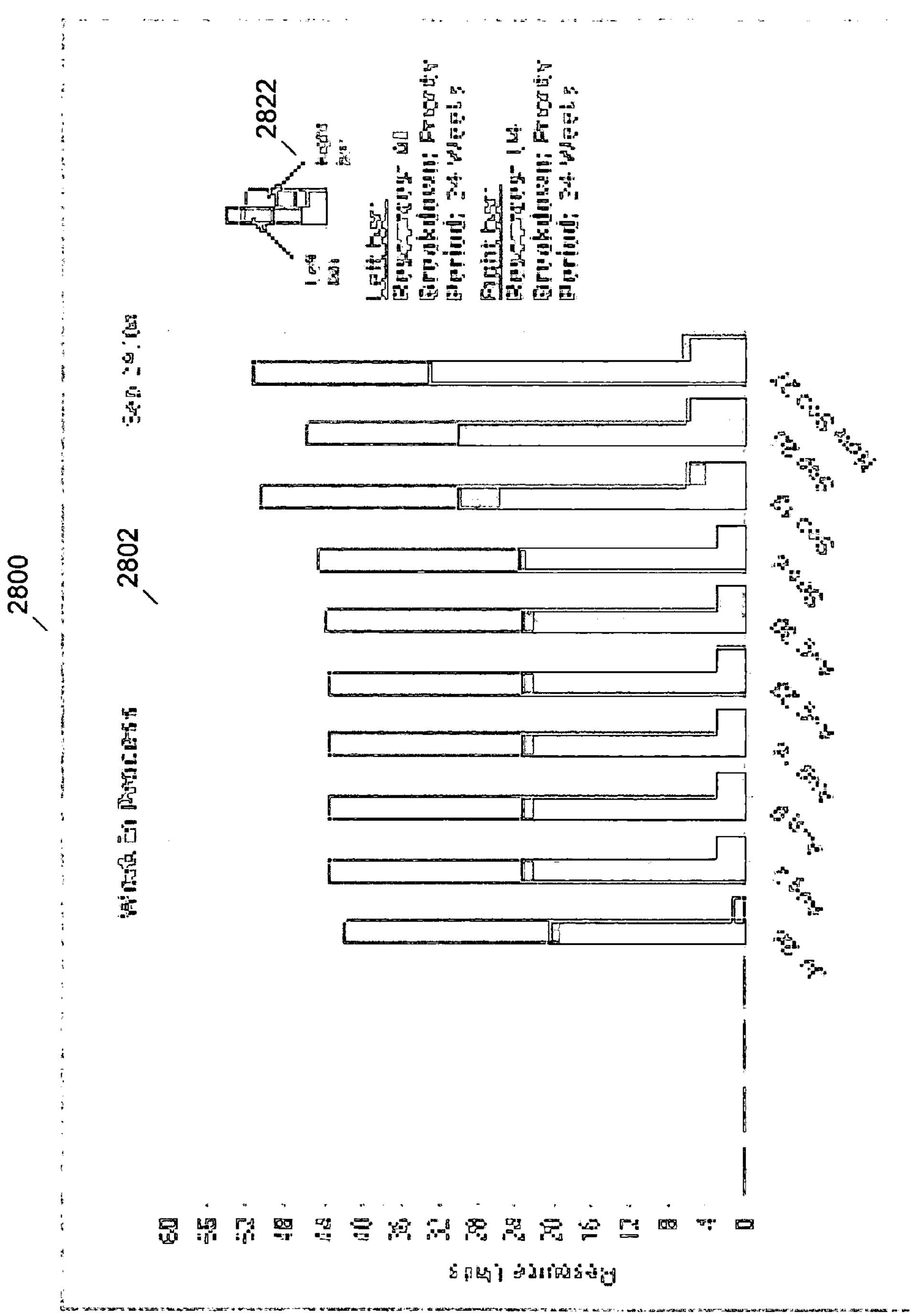


FIG. 28

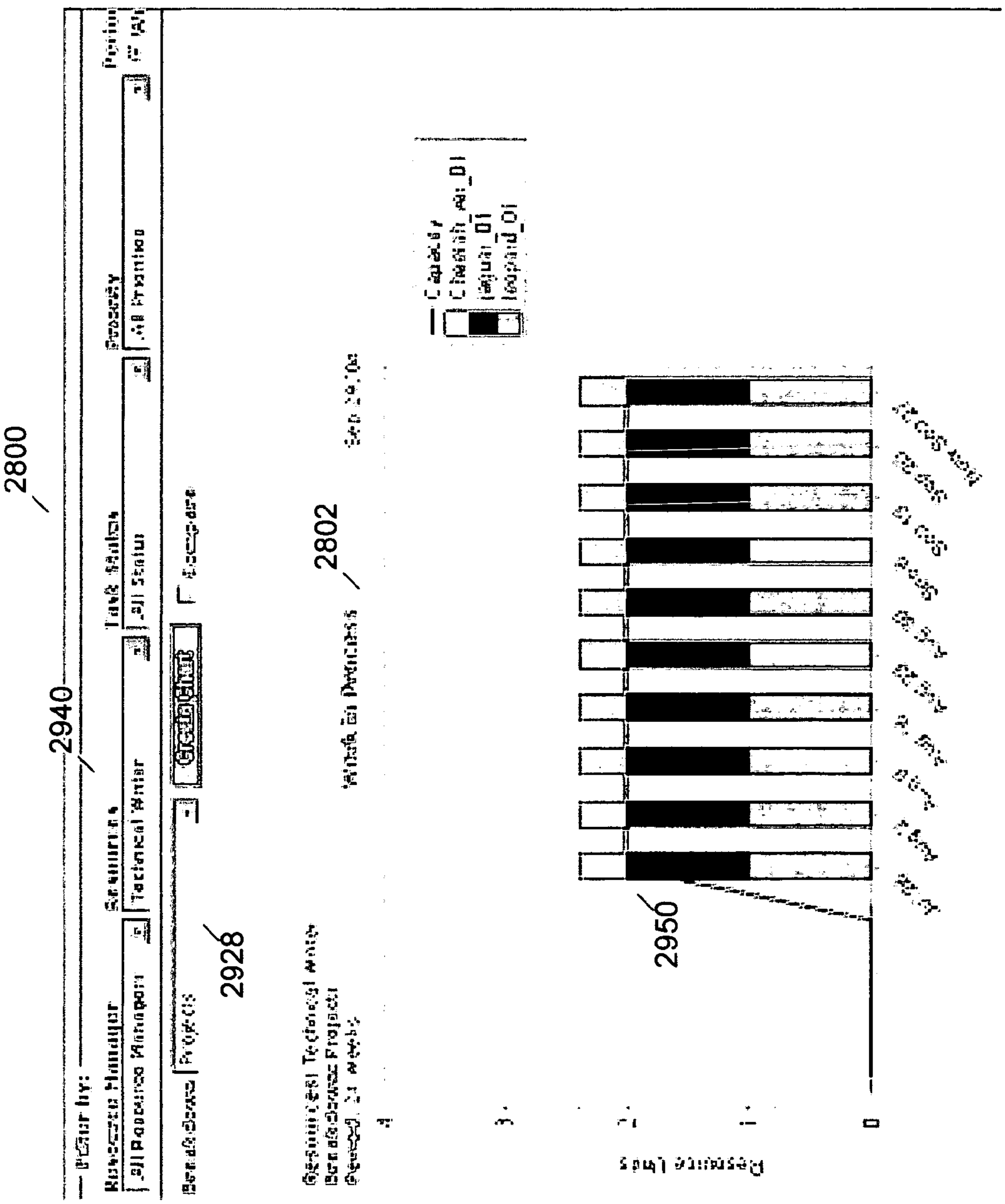


FIG. 29

FACILITATION OF MULTI-PROJECT MANAGEMENT USING THROUGHPUT MEASUREMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

The present U.S. Patent Application is a continuation-in-part of U.S. patent application Ser. No. 10/700,431 filed on Nov. 4, 2003 and entitled "Facilitation of Multi-Project Management Using Critical Chain Methodology." The present U.S. Patent Application claims priority to U.S. patent application Ser. No. 10/700,431, which is hereby incorporated by reference in its entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable.

INCROPORATION BY REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC

Not Applicable.

FIELD OF THE INVENTION

This invention generally relates to the field of project management and more specifically to efficient critical chain-based project management utilizing throughput measurements.

BACKGROUND OF THE INVENTION

In recent years, project management software has gained increasing popularity. Close to $2 billion is spent on project management software every year. However, it is still the case that most projects, regardless of industry or type, are delivered late, over budget and under scope. Consider the statistics that show 1) over 83% of information technology (IT) projects are delivered late or over-budget, 2) projects completed by large companies have only 42% of the originally designed features and functions, 3) over 85% of engineering projects in the semiconductor industry finish late, 4) on average, high-tech projects are late by 100% despite the use of project management software and traditional tools, 5) 80% of all embedded systems are delivered late and 6) most defense projects take too long and cost too much.

Currently, a popular approach to project management is the critical path project management methodology. The critical path project management methodology has been utilized in the industry for many years. In brief, the critical path methodology teaches that every project or set of projects has one critical path that must be managed in order to realize established goals. According to the theory, every project has one longest chain of tasks/events, i.e., the critical path, which should be managed in order to maintain time and budget goals. This approach, however, does not allow for the possibility that the critical path keeps changing due to uncertainties. These uncertainties affect projects adversely and are typically the reason for time and budget overruns for large projects.

In theory, if you create a good plan and follow it, your projects will be completed on time. In reality, too many uncertainties arise along the way: requirements change, technology fails, vendors do not deliver, work materializes slower than expected, approvals are not granted on time and priorities change. As uncertainties strike, plans go awry.

Uncertainties can affect projects adversely in several ways. The cascade effect propagates delays but does not allow for the realization of gains. Projects lose time because either all of the preceding activities have not finished, or the needed resources are working elsewhere. Substantial time and capacity are lost as a result. Additionally, resources go idle waiting for work to arrive. Such idling is often not visible because people can continue to fine-tune already completed work in the meantime.

Another way in which uncertainties can affect projects adversely is multitasking, whereby people shuttle between tasks, killing productivity and stretching projects. As schedules start slipping, people are needed on multiple projects at once. As people shuttle between tasks without finishing one at a time (multitasking), this results in duration stretch, whereby each task takes longer, switching costs, whereby extra capacity is needed for task set-up and set-down, and concentration lapse, whereby quality suffers when people cannot concentrate on one task at a time.

Yet another way in which uncertainties can affect projects adversely is human behavior, whereby safeties are hidden in commitments. Having experienced constant delays, workers quickly learn to hide safeties in their estimates. However, these safeties are invariably wasted because of procrastination. With safeties embedded in commitments, it only becomes more tempting to take a slow start. Safeties are also wasted because of a lack of reporting early finishes. People do not report early finishes because they are afraid that the next time, these early finishes will become hard expectations.

A new approach to project management, the critical chain project management methodology, offers a solution to manage uncertainties in a single project environment, where resources are dedicated to individual projects. A key component to this approach suggests putting blocks of unscheduled time, called buffers, at key integration points in project plans to absorb the shocks of uncertainties. Another key component of the critical chain project management methodology suggests that buffers are managed during execution to ensure the project meets established time goals. A description of the critical chain-based project management method was first published in *Critical Chain*, by Eliyahu M. Goldratt, North River Press 1997.

This new project management approach, however, has been very difficult to implement in multi-project environments. This is because resources in a multi-project environment are not just dedicated to one project, but instead are shared across multiple projects. In a multi-project environment, buffer management based on a single project fails to work. In this environment, task priorities are needed not just within one project, but among multiple projects. Furthermore, most multi-project teams are located in multiple locations and are managed by individual project managers. These disparate teams, however, draw upon a common pool of resources on a timely basis. For this reason, implementing the critical chain project management methodology in a multi-project environment requires multi-project buffer management. Specifically, multi-project buffer management is needed in order to provide task priorities across multiple projects. Current project management software lacks multi-project buffer management and task priorities across multiple projects, hampering an organization's ability to deliver multiple projects on time and within budget.

One common problem with existing project management software based on critical chain is the lack of task prioritization across projects. Task prioritization refers to the calculation of priority for each task. Task priorities are important during execution since task managers must be able to identify, at any given time, those tasks that are most critical to the timely completion of the project. Existing project management packages based on critical chain calculate task priority within a project using a simple formula that merely reports the status of buffers, and leaves it up to the project manager to figure out what to do as a result. This is inadequate in large multi-project environments since true task priorities should include priorities across multiple projects, and should be based on multiple factors such as relative project priority, relative buffer priority, buffer consumption rates and other factors. Without the calculation of task priorities across multiple projects, managers are unable to see the Big Picture and hence properly prioritize people and resources to the correct tasks. The calculation of a task priority for a single project shows only a partial priority of a particular task.

Yet another common problem with existing project management software based on critical chain is buffer management. Currently, buffer management is executed by an administrator sitting at a workstation that is part of a network implementing the project management software. The administrator is unable to be mobile while still performing the duties of buffer management. This is inadequate and restricts the actions of the administrator.

Yet another common problem with existing project management software based on critical chain is the lack of ability to measure throughput adequately and identify execution-time bottlenecks or problem areas. As explained above, for complex or multiple projects, while a project-level progress measurement is available using buffer status, progress measurement is required at a system-level to ensure that resources are following priorities and work is proceeding at the right pace, and to identify where delays are occurring. While resource constraints can be identified based on capacity during planning, execution-time bottlenecks can arise in areas different from those identified during planning. A predictive progress measurement is needed for identifying these bottlenecks so that managers can take action. Making these progress measurements and identifying problem areas requires additional time and effort by administrators in tracking and analyzing a large number of tasks and resources. Even when a problem is identified, it can be further difficult to determine the particular resource, task manager, or resource manager where a focused effort can be made to cure the problem or bottleneck. Often, managers will identify a general area that causes delays and initiate a major overhaul or reorganization of the entire area in order to affect change. This can be inefficient and time-consuming.

Therefore a need exists to overcome the problems discussed above, and particularly for a way to facilitate critical chain-based project management to more efficiently measure throughput and identify problem areas in the task network.

SUMMARY OF THE INVENTION

The present invention, according to a preferred embodiment, overcomes problems with the prior art by providing an efficient and easy-to-implement critical chain-based project management system utilizing throughput measurement.

In an embodiment of the present invention, a method on a computer for providing critical chain-based project management is disclosed. The method includes generating a list of sequential time periods for a project comprising a plurality of tasks and calculating a number of tasks for each time period. The method further includes generating a graphic that visually indicates the number of tasks for each time period and a priority of each task and providing the graphic to a user.

In another embodiment of the present invention, an alternative method on a computer for providing critical chain-based project management is disclosed. The method includes generating a list of sequential time periods for a project comprising a plurality of tasks, wherein a task is either in-progress or pending and calculating a number of in-progress and pending tasks for each time period. The method further includes generating a first graphic that visually indicates a number of in-progress tasks for each time period and a priority of each in-progress task. The method further includes generating a second graphic that visually indicates a number of pending tasks for each time period and a priority of each pending task and providing the first and second graphic to a user.

In another embodiment of the present invention, a computer system for providing critical chain-based project management is disclosed. The computer system comprises a database for storing a project plan for a project comprising a plurality of tasks. The computer system further comprises a processor configured for: generating a list of sequential time periods for the project, calculating a number of tasks for each time period, and generating a graphic that visually indicates the number of tasks for each time period and a priority of each task. The computer system further comprises an interface for providing the graphic to a user.

In another embodiment of the present invention, a method on a computer for providing critical chain-based project management is disclosed. The method includes generating a list of sequential time periods for a project comprising a plurality of tasks and calculating a resource load for tasks pertaining to each time period. The method further includes generating a graphic that visually indicates the resource load for tasks pertaining to each time period and a priority of each task and providing the graphic to a user.

The foregoing and other features and advantages of the present invention will be apparent from the following more particular description of the preferred embodiments of the invention, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter, which is regarded as the invention, is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features and also the advantages of the invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings.

FIG. **1** is a block diagram illustrating the client-server architecture of one embodiment of the present invention.

FIG. **2** is a more detailed block diagram illustrating the overall architecture of one embodiment of the present invention.

FIG. **3** is an operational flow diagram showing the overall project management process according to one embodiment of the present invention.

FIG. **4** is a block diagram illustrating the planning phase of the project management process according to one embodiment of the present invention.

FIG. **5** is an operational flow diagram showing the planning phase of the project management process according to one embodiment of the present invention.

FIG. **6** is a screenshot of a graphic showing a project plan.

FIG. **7** is a screenshot of a graphic showing a project plan with buffers in one embodiment of the present invention.

FIG. **8** is a screenshot of a pipelining user interface for date reconciliation in one embodiment of the present invention.

FIG. **9** is a screenshot of a pipelining user interface for resource reconciliation in one embodiment of the present invention.

FIG. **10** is a block diagram illustrating the execution phase of the project management process according to one embodiment of the present invention.

FIG. **11** is a screenshot of a task updating user interface in one embodiment of the present invention.

FIG. **12** is an illustration of a project status graph report in one embodiment of the present invention.

FIG. **13**A is a screenshot of a first task prioritization user interface in one embodiment of the present invention.

FIG. **13**B is a screenshot of a second task prioritization user interface in one embodiment of the present invention.

FIG. **14** is an operational flow diagram showing the task prioritization calculation process according to one embodiment of the present invention.

FIG. **15** is a block diagram of an information processing system useful for implementing the present invention.

FIG. **16** is an operational flow diagram showing the throughput measurement graphic generation process according to one embodiment of the present invention.

FIG. **17** is an operational flow diagram showing another throughput measurement graphic generation process according to another embodiment of the present invention.

FIG. **18** is a screenshot of a user interface showing a throughput measurement graphic in one embodiment of the present invention.

FIG. **19** is a screenshot of another user interface showing a throughput measurement graphic in one embodiment of the present invention.

FIG. **20** is a screenshot of yet another user interface showing a throughput measurement graphic in one embodiment of the present invention.

FIG. **21** is a screenshot of the user interface of FIG. **20** after additional selections have been made.

FIG. **22** is a screenshot of the user interface of FIG. **21** after additional selections have been made.

FIG. **23** is a screenshot of the user interface of FIG. **22** after additional selections have been made.

FIG. **24** is a screenshot of the user interface of FIG. **23** after additional selections have been made.

FIG. **25** is a screenshot of the user interface of FIG. **24** after additional selections have been made.

FIG. **26** is a screenshot of the user interface of FIG. **25** after additional selections have been made.

FIG. **27** is a screenshot of the user interface of FIG. **26** after additional selections have been made.

FIG. **28** is a screenshot of another user interface showing a throughput measurement graphic in one embodiment of the present invention.

FIG. **29** is a screenshot of the user interface of FIG. **28** after additional selections have been made.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

It should be understood that these embodiments are only examples of the many advantageous uses of the innovative teachings herein. In general, statements made in the specification of the present application do not necessarily limit any of the various claimed inventions. Moreover, some statements may apply to some inventive features but not to others. In general, unless otherwise indicated, singular elements may be in the plural and vice versa with no loss of generality. In the drawing like numerals refer to like parts through several views.

The present invention, according to a preferred embodiment, overcomes problems with the prior art by providing multi-project buffer management for an efficient and easy-to-implement multi-project management system utilizing the critical chain methodology.

One advantage of the present invention is the calculation of task priorities while taking a multitude of factors into account, such as buffer priorities, the amount of buffer consumed by a task, chain lengths, maximum buffer consumption, the amount of the current chain that has been completed, amount of buffer recovered, and other factors. Another advantage of the present invention is the calculation of task priorities among multiple projects. Implementing the critical chain project management methodology in a multi-project environment requires multi-project buffer management. Thus, the present invention provides multi-project buffer management in order to provide task priorities across multiple projects. The calculation of task priorities across multiple projects allows managers to assign resources based on the overall need of all projects.

Yet another advantage of the present invention is online buffer management. It is beneficial for all buffer management related functions to be performed over the Web in a client-server environment, such as a project manager submitting a project over the Web. This eliminates the need for a project manager to create a project at a particular computer. It is further beneficial as execution processes can occur over the Web, such as the updating of task manager statuses and the submission of completed work. Additionally, it is beneficial for buffer management settings to be configured over the Web, eliminating the need for an administrator to sit at a particular workstation. Lastly, it is beneficial for buffer management reports to be viewed easily over a network. This allows a wider audience greater access to status and progress information.

The present invention, according to a preferred embodiment, further overcomes problems with the prior art by providing a user-friendly and efficient critical chain-based project management system utilizing a throughput measurements. This feature of the present invention provides the advantage of allowing for quick and easy generation of graphs or charts that visually indicate the throughput of a system, allows a user to breakdown throughput measurements by status and priorities, and allow the user to measure throughput at various levels of an organization. This allows a user, such as a manager or a division head, to identify when queues are building up, thereby creating longer wait times, and identify bottlenecks or opportunities to increase throughput of the system. This allows focused corrective actions to be taken at a local level.

FIG. **1** is a block diagram illustrating the client-server architecture of one embodiment of the present invention. The exemplary embodiments of the present invention adhere to the system architecture of FIG. **1**. FIG. **1** shows an embodiment of the present invention wherein clients interact with a critical chain-based project management system over a network, such as in an enterprise implementation of the project management system that services multiple users in more than one location and for multiple projects. FIG. **1** shows client computers **106** through **108** connected to a network **104**. It should be noted that although FIG. **1** shows only two client computers **106** and **108**, the system of the present invention supports any number of client computers. FIG. **1** also shows a project management server system **102**, which may be critical chain-based, connected to the network **104**. The project management server system **102** is described in more detail with reference to FIG. **3** below.

In an embodiment of the present invention, the computer systems of client computers **106** through **108** and server system **102** are one or more Personal Computers (PCs), Personal Digital Assistants (PDAs), hand held computers, palm top computers, lap top computers, smart phones, game consoles or any other information processing devices. A PC can be one or more IBM or compatible PC workstations running a Microsoft Windows or LINUX operating system, one or more Macintosh computers running a Mac OS operating system, or an equivalent. In another embodiment, the client computers **106** through **108** and server system **102** are a server system, such as SUN Ultra workstations running a SunOS operating system or IBM RS/6000 workstations and servers running the AIX operating system. The computer systems of computers **106** through **108** and server system **102** are described in greater detail below with reference to FIG. **15**.

In an embodiment of the present invention, the network **104** is a circuit switched network, such as the Public Service Telephone Network (PSTN). In another embodiment, the network **104** is a packet switched network. The packet switched network is a wide area network (WAN), such as the global Internet, a private WAN, a local area network (LAN), a telecommunications network or any combination of the above-mentioned networks. In yet another embodiment, the structure of the network **104** is a wired network, a wireless network, a broadcast network or a point-to-point network.

FIG. **2** is a more detailed block diagram illustrating the overall architecture of one embodiment of the present invention. FIG. **2** shows more detail regarding the client-server nature of the present invention, as shown in FIG. **1**.

FIG. **2** shows the components of the project management server system **102**, which may be critical chain-based, connected to the network **104**. The project management server system **102** includes a database **206**, a database management system **204** and a project management application **202**. The database **206** is a repository for data used by project management application **202** during the course of the management of a project or projects. The database **206** includes all information necessary for performing the functions of the project management server system **102**, including project planning, project execution, buffering, pipelining, task updating, etc. These functions are described in greater detail below. The database **206** also includes project setting information, user information, reports, and other information that is modified or accessed by the project management application **202** during the course of a project or projects. Database **206** can be any commercially database, such as an Oracle Database, Enterprise or Personal Edition, available from Oracle Corporation, or a Microsoft SQL Server or Access **2000** database available from Microsoft Corporation.

Database management system **204** is an application that controls the organization, storage and retrieval of data (fields, records and files) in database **206**. The database management system **204** accepts requests for data from the project management application program **202** and instructs the operating system to transfer the appropriate data. Database management system **204** may also control the security and integrity of the database **206**. Data security prevents unauthorized users from viewing or updating certain portions of the database **206**. Database management system **204** can be any commercially database management system, such as the Oracle E-Business Suite available from Oracle Corporation.

FIG. **2** also shows the project management application **202**, which performs substantially the functions of the present invention, as described in greater detail below. Project management application **202** connects directly to the network **104** via a network interface, such as a network interface card. Optionally, the project management server system **102** includes a Web server that connects to the network **104** via a network interface. The project management application **202** is logically connected to the Web server, which provides a Web interface available to clients (such as clients **106** through **108**) of the project management server system **102**. This option is advantageous as a Web interface allows any clients having a Web browser to connect to the project management server system **102**. A Web interface provides a simple, efficient, highly compatible, economical and highly available connection to the project management server system **102** to a wide range of clients.

FIG. **2** further shows a group of clients for connecting to the project management server system **102**. These clients include a single project-planning client **212**, a buffering client **214**, and a resource reconciliation client **216**, otherwise known as a pipelining client **216**. The single project planning client **212** allows a project manager to generate and submit a project plan to the project management server system **102**. The buffering client **214** modifies a project plan to include a required set of buffers. The resource reconciliation client **216** processes all project plans and reconciles all resource conflicts in order to produce a master project plan. The resource reconciliation client **216**, or pipelining client, performs cross-project or multiple project planning, as opposed to single project planning.

Single project planning client **212**, the buffering client **214**, and the resource reconciliation client **216** are client applications, such as C++, Visual Basic, Java applet, a Java scriptlet, Java script, Perl script, an Active X control or any self-sufficient application executing on a client computer. The clients of FIG. **2** can communicate with the project management server system **102** via a Web interface such as a commercially available Web browser, e.g., Netscape Navigator and Microsoft Internet Explorer. The functions of the single project planning client **210**, the buffering client **214**, and the resource reconciliation client **216** are described in greater detail below.

FIG. **2** further shows a settings module **210** for configuring the settings for the project management server system **102**. Settings module **210** can be used to manage user and group accounts, manage user and group permissions and authorizations, set use policies, set system and Web interface parameters, modify configuration settings on the project management server system **102** and the like. Settings module **210** is a client application, such as an application programmed in C++, Visual Basic, a Java applet, a Java scriptlet, Java script, Perl script, an Active X control or any self-sufficient application executing on a client computer. The settings module **210** can communicate with the project management server system **102** via a Web interface such as a commercially available Web browser. Alternatively, the settings module **210** is a simple Web interface realized through a commercially available Web browser, wherein the user enters and/or modifies settings via a Web page.

FIG. **2** further shows a task-updating module **218**, used by task managers to update the status of tasks and projects with the project management server system **102** during the course of a project or projects. The task-updating module **218** can be used to manage the creation and modification of task information for projects, before and during execution. The task-updating module **218** can further be used to update task statuses, forecast how much more time it will take to finish the task, modify task attributes, provide information on what may be holding up a task, and the like. The task updating module **218** is a client application, such as an application programmed in HTML or XML, a Java applet, a Java scriptlet, Java script, Perl script, an Active X control or any self-sufficient application executing on a client computer. The task-updating module **218** can communicate with the project management server system **102** via a Web interface such as a commercially available Web browser. Alternatively, the task-updating module **218** is a simple Web interface realized through a commercially available Web browser, wherein the user enters and/or modifies task information via a Web page. The functions of the task-updating module **218** are described in greater detail below.

FIG. **2** further shows a reports module **220**, used by task and project managers to evaluate the status of a project or projects with the project management server system **102** during the course of a project or projects. The reports module **220** can be used to download various kinds of reports, such as progress chart and graphs, which can be used to evaluate the status of a project during execution. The reports module **220** is a client application, such as a Java applet, a Java scriptlet, Java script, Perl script, an Active X control, an application programmed in HTML or XML or any self-sufficient application executing on a client computer. The reports module **220** can communicate with the project management server system **102** via a Web interface such as a commercially available Web browser. Alternatively, the reports module **220** is a simple Web interface realized through a commercially available Web browser, wherein the user selects reports for download via a Web page.

FIG. **2** further shows a flow trend module **222**, used by task and project managers to evaluate and measure the throughput of a project or projects within the project management server system **102** during the course of a project or projects. The flow trend module **222** can be used to download and/or generate various kinds of reports, such as charts, spreadsheets or graphs, which can be used to evaluate the throughput of a project during execution. The flow trend module **222** is a client application, such as a Java applet, a Java scriptlet, Java script, Perl script, an Active X control, an application programmed in HTML or XML or any self-sufficient application executing on a client computer. The flow trend module **222** can communicate with the project management server system **102** via a Web interface such as a commercially available Web browser. Alternatively, the flow trend module **222** is a simple Web interface realized through a commercially available Web browser, wherein the user selects reports for creation and/or download via a Web page.

It should be noted that in the embodiment of the present invention described above, the modules **210**, **218**, **220** and **222** and the clients **212**, **214** and **216** are depicted as separate from the project management server system **102**. In this embodiment, the modules **210**, **218**, **220** and **222** and the clients **212**, **214** and **216** communicate with the computer system of the project management server system **102** over a network **104** or other communication medium. In an alternative embodiment of the present invention, any one or all of the modules **210**, **218**, **220** and **222** and the clients **212**, **214** and **216** can be integrated with the computer system of the project management server system **102**. In this alternative embodiment, those modules or clients that are integrated with the project management server system **102** share the same resources as the project management server system **102**.

FIG. **3** is an operational flow diagram showing the overall project management process according to one embodiment of the present invention. FIG. **3** shows the three main phases of any project management process: the planning phase, the execution phase and the post-execution analysis phase. The operation and control flow of FIG. **3** begins with step **302** and proceeds directly to step **304**.

In step **304**, the pre-execution planning phase includes such functions as configuring settings, generating and submitting single projects, buffering of projects, multiple project planning, and other functions. Functions of the planning phase are described in more detail with reference to FIGS. **4** through **9** below. The pre-execution planning phase further includes a portfolio optimization function that allows high-level project planning. The portfolio optimization function calculates those project objectives that can be met with the available project resources. Conversely, portfolio optimization function can calculate the project resources necessary to meet those project objectives that are most desirable.

In step **306**, the execution phase of the project management process includes the functions of buffer management, task updating, report generation and other functions. The functions of the execution phase are described in more detail with reference to FIGS. **10-14** below. Lastly, in step **308**, the post-execution analysis phase includes a performance diagnostic function wherein project managers and other administrators can review the execution of the project or projects. The performance diagnostic function can be used to determine problem items, such as bottlenecks, or buffer-consuming tasks/projects, and to determine resource deficiencies of a project or projects. In step **310**, the operational flow diagram of FIG. **3** stops.

FIG. **4** is a block diagram illustrating the planning phase of the project management process according to one embodiment of the present invention. FIG. **4** shows more detail of the pre-execution planning phase of step **304** of FIG. **3**, including the functions of configuring settings, generating and submitting single projects, buffering of projects, multiple project planning, and other functions. FIG. **4** begins with the generation of a project plan by the single project-planning client **212**.

In FIG. **4**, the single project-planning client **212** accesses a project template **404** from a project template bank **402**. A project template **404** is a template of a project plan, defined beforehand such that projects of similar type and/or scope need not be generated from scratch by a project manager. Project templates can be re-used among project managers in order to save time and resources. The project template bank **402** is a database or repository of project templates. In an embodiment of the present invention, the project template bank **402** can be any commercially database, such as an Oracle Database.

A project manager interacts with the single project-planning client **212** in order to generate a project plan **408** based on the project template **404** from the project template bank **402**. The project plan **408** is then submitted to the project management system **102**, for example, over the Web via a Web page or over the Internet via an email message. A project plan **408** is a map, table, chart or any other organization of information that shows the intended progression of a project from start to finish. In one embodiment of the present invention, Microsoft Project, a project management application available from Microsoft Corporation, is used as the single project-planning client **212** to create a project plan. In this embodiment, Microsoft Project, which does not utilize a critical chain-based project management methodology, is used in conjunction with a plug-in, API or standalone application that offers critical chain-based calculations for generating a project plan.

FIG. **6** is a screenshot of a graphic showing a project plan. FIG. **6** shows an example of a graphic depicting a project plan **402** generated using Microsoft Project. The graphic of FIG. **6** shows chronological dates along the top axis of the graphic **602**. The project plan comprises individual tasks, shown as task blocks **604**, **606** and **608** in the graphic. The length of each task block dictates the amount of time that is required to complete each task. Also shown are connecting lines, such as lines **610** and **612**, which connect task blocks **604** and **606**, as well as **606** and **608**. These connecting lines show the interdependence of task blocks, such as the interdependence of task blocks **604** and **606**. As depicted, the completion of task **606** depends on the completion of task **604**.

Returning to FIG. **4**, the generation of a project plan **408** by the single project-planning client **212** gives way to the buffering client **214**, which inserts buffers into the project plan **408**. The critical chain-based methodology of Goldratt (see bibliography above) teaches the use of various types of buffers that are used to protect time deadlines and budget goals in the event of uncertainties during project execution. Four types of buffers are used: project buffers located at the end of a project, feeding buffers located at the point at which one set of tasks or projects feeds into another set of tasks or projects, milestone buffers that are located at project milestones and project-to-project (or P2P) buffers that are located at points where one project feeds into another project. The buffering client **214** processes the project plan **408** and inserts the aforementioned buffers into the project plan **408**, resulting in a project plan with buffers **406**.

FIG. **7** is a screenshot of a graphic showing a project plan with buffers in one embodiment of the present invention. FIG. **7** shows an example of a graphic depicting a project plan with buffers **406** generated using Microsoft Project. The graphic of FIG. **7** shows chronological dates along the top axis of the graphic **702**. The project plan comprises individual tasks, shown as task blocks in the graphic. The length of each task block dictates the amount of time that is required to complete each task. Also shown are connecting lines that connect task blocks. These connecting lines show the interdependence of task blocks. FIG. **7** also shows examples of feeding buffers, **704**, **706**, **708**, **710** and **712**. Each of the feeding buffers is located at the end of a set of tasks that are being fed into another set of tasks. FIG. **7** also shows an example of a project buffer **715**. The project buffer **715** is located at the end of the entire project, thus protecting the predicted finish for the entire project.

Returning to FIG. **4**, the generation of a project plan with buffers **406** by the buffering client **214** gives way to the pipelining client **216**, which processes all project plans and reconciles all resource conflicts in order to produce a master project plan **414**. The pipelining client **216**, or resource reconciliation client, performs cross-project or multiple project planning, as opposed to single project planning. The pipelining client **216** takes as input the project plan with buffers **406**, generated by the buffering client **214**. The pipelining client **216** also takes an input all other project plans **412** for the entire project, as well as a global resource table **410**. The global resource table **410** is a complete set of resources that are available for the completion of all projects. Resources include man hours associated with workers, computing resources, raw materials, equipment, etc.

The pipelining client **216** performs a variety of functions, one of which is described with reference to FIG. **8**. The pipelining client **216** allows a user to set a project completion date for one, more than one or all projects in a set of projects and provide the result of such date constraints on the over project plan. For example, see FIG. **8**. FIG. **8** is a screenshot of a pipelining user interface **800** for date reconciliation in one embodiment of the present invention. The user interface **800** shows that a project "puma_02" has been selected from a set of sub-projects of a greater project, as shown in the text field **802**. The user may enter a requested completion date of the sub-project "puma_02" into the text field **804**. Once a date has been entered, the user may press the "Test Impact" button **806** to test the impact on the other sub-projects and the project as a whole of mandating the requested completion date entered by the user.

The impact is shown in the window **808**, which lists all sub-projects and project data associated with each sub-project. For each sub-project the window **808** shows a variety of information such as the projected date of completion in column **810**, the additional lateness of the date of completion in column **812**, the cumulative lateness of the date of completion in column **814**, and the buffer status in column **816**. As the user presses the "Test Impact" button **806** to test the impact of mandating the requested completion date entered by the user, the pipelining client **216** performs calculations to determine the impact of such a mandate on the other sub-projects. Inevitably, as one sub-project is elevated in priority, other sub-projects are downgraded in priority. As a result, as the completion date of the sub-project "puma_02" is mandated, the projected date, or lateness of the other sub-projects may suffer. In this way, a project manager may modify sub-project priorities to reach the optimal combination of completion dates.

Another function of the pipelining client **216** is described with reference to FIG. **9**. The pipelining client **216** allows a user to set resource loads in order to meet time and budget goals. For example, see FIG. **9**. FIG. **9** is a screenshot of a pipelining user interface **900** for resource reconciliation in one embodiment of the present invention. The user interface **900** shows a list of resources, such as the diagnostic engineer resource **904**, on the bar chart **902** and the load on each resource is shown as the entire horizontal bar adjacent to a resource name, such as bar **906**. A load is defined as the percentage of an available resource that is scheduled for use during a project. For example, if a worker is available for working a total of 2,000 man-hours in one year and the project schedules the worker for 1,000 man-hours worth of tasks for the year on the project, then the load on the worker is 50%.

Whereas the load on each resource is shown as the entire horizontal bar adjacent to a resource name, the red or dark portion of the bar indicates that portion of the resource that is scheduled on tasks that are part of the critical chain. According to the critical chain-based project management methodology, every project or set of projects has one critical chain of tasks/events that must be protected in order to realize established goals. The critical chain should be prioritized in order to maintain time and budget goals.

FIG. **9** shows that the diagnostic engineer resource **904** has been constrained, as indicated by an icon **908**. To constrain means to normalize a resource to be loaded to a percentage below 100%. It may be that before the diagnostic engineer resource **904** was constrained, the resource was loaded to more than 100%. This occurs when the pipelining client **216** produces the resource load chart **902** based on a list of user objectives, wherein the objectives only took time goals, and not resource constraints, into account. Thus, the purpose of the pipelining client **216** is to reconcile resource constraints among the various sub-projects of a greater project. Once the diagnostic engineer resource **904** has been constrained to a load below 100%, the chart **902** shows that all other resources are also below 100% load. In this way, a project manager may adjust loads and objectives in order to reach the optimal combination of resource loads, objectives and completion dates.

FIG. **5** is an operational flow diagram showing the planning phase of the project management process according to one embodiment of the present invention. FIG. **5** shows more detail of the planning phase of step **304** of FIG. **3**, including the functions of configuring settings, generating and submitting single projects, buffering of projects multiple project planning, and other functions. FIG. **5** begins with step **502** and proceeds immediately to step **504**.

In step **504**, the settings of the project management server system **102** are configured by a user, such as a system administrator or a project manager. The settings module **210** can be used for configuring the settings of the project management server system **102**. Settings module **210** can be used to manage user and group accounts, manage user and group permissions and authorizations, set use policies, set system and Web interface parameters, modify configuration settings on the project management server system **102** and the like. As explained above, the settings module **210** can be a simple Web interface realized through a commercially available Web browser, wherein the user enters and/or modifies settings via a Web page.

In step **506**, the single project-planning client **212** accesses a project template **404** from a project template bank **402**. A project template **404** is a template of a project plan, defined beforehand such that projects of similar type and/or scope need not be generated from scratch by a project manager. In step **508**, a project manager interacts with the single project-planning client **212** in order to generate a project plan **408** based on the project template **404** from the project template bank **402**. A project plan **408** is a map, table, chart or any other organization of information that shows the intended progression of a project from start to finish. The generation of a project plan **408** by the single project planning client **212** gives way to the buffering client **214**, which inserts buffers into the project plan **408** in step **510**. The buffering client **214** processes the project plan **408** and inserts a variety of buffers into the project plan **408**, resulting in a project plan with buffers **406**.

The generation of a project plan with buffers **406** by the buffering client **214** gives way to the pipelining client **216**, which processes all project plans and reconciles all resource conflicts in step **512**. The pipelining client **216**, or resource reconciliation client, performs cross-project or multiple project planning, as opposed to single project planning. The pipelining client **216** takes as input the project plan with buffers **406**, generated by the buffering client **214**. The pipelining client **216** also takes an input all other project plans **412** for the entire project, as well as a global resource table **410**. The global resource table **410** is a complete set of resources that are available for the completion of all projects The result of the pipelining client **216** is a master project plan **414**, in step **514**. In step **516**, the operational flow of FIG. **5** stops.

Critical chain-based project management methodology includes two main components: the placement of buffers in the correct locations of a project plan and using the status of these buffers during execution to decide what tasks to focus on. This second component is called buffer management. The main idea of buffer management is that the rate at which buffers are depleting is monitored and priority is given to tasks that lie on chains where buffers are fast depleting. In a multi-project environment, however, this simplistic idea is difficult to implement Project employees often work on multiple projects at the same time, and hence need not only task priorities within a project, but also across projects. This is a complex problem as comparing tasks among different projects is like comparing apples to oranges: some projects have higher strategic priorities, certain milestones in a project that need to be delivered first and individual projects have different amounts of buffer placed in their project plans. This is compounded by the fact that project employees are often located in different places.

The present invention provides multi-project buffer management that allows organizations to use buffer management in a complex environment, where resources are shared across projects. Task priorities are driven by a combination of relative project priority, relative milestone priority and buffer consumption by each task, requiring a complex set of algorithms. The buffer management process is further Web enabled so that project managers can configure buffering policies over the Web, submit project plans with buffers over the Web, do task updates over the Web, run buffer management functions using the Web, and acquire buffer reports over the Web. Current critical chain-based project management solutions lack the capability of multi-project buffer management, and only have capability for a single project buffer management and thus at best work only when resources are dedicated to one project.

FIG. **10** is a block diagram illustrating the execution phase of the project management process according to one embodiment of the present invention. FIG. **10** shows more detail of the execution phase of step **306** of FIG. **3**, including the functions of buffer management, task updating, task prioritization, report review and other functions. FIG. **10** shows that the buffer management process **1002** comprises three components, task updating (as performed by task updating module **218**), report review (wherein reports are provided by reports module **220**) and task prioritization (as performed by task prioritization module **1004**).

FIG. **10** shows the updating of task statuses via the task-updating module **218**. The task-updating module **218** is used by task managers to update the status of tasks and projects with the project management server system **102** during the course of a project or projects. The task-updating module **218** can be used to manage the creation and modification of task information for projects, before and during execution. The task-updating module **218** can further be used to update task statuses, forecast how much more time it will take to finish the task, modify task attributes, provide information on what may be holding up a task, and the like. As explained above, the task updating module **218** can be a simple Web interface realized through a commercially available Web browser, wherein the user enters and/or modifies task information via a Web, page.

The task-updating module **218** performs a variety of functions, one of which is described with reference to FIG. **11**. FIG. **11** is a screenshot of a task updating user interface **1100** in one embodiment of the present invention. The user interface **1100** can be realized as a Web page accessible over the Web by a Web browser. The user interface **1100** shows all tasks for a particular task manager, as indicated in text field **1120**, starting on a particular date, as indicated in text field **1122**, and for a specified period of time, as indicated in text field **1124**. The aforementioned text fields allow for different views of information by selecting various selections in the aforementioned text fields, such as selecting a different task manager in the text field **1120**.

The user interface **11100** shows a list of tasks and, for each task, a task description in column **1106**, a task earliest completion date in column **1108**, a task status in column **1110**, a remaining duration for the task in column **1112** and a last update date in column **1114**. As task managers administer the progress of their respective tasks, they can access the user interface **1100** and update certain pieces of information, such as a task status in column **1110** and a remaining duration for the task in column **1112**. This information is then used during the execution of the project to determine the status of the project.

Returning to FIG. **10**, also shown is the reports module **220** for the generation and/or download of reports during execution of the project. The reports module **220** is used by task and project managers to evaluate the status of a project or projects of the project management server system **102** during the course of a project or projects. The reports module **220** can be used to download various kinds of reports, such as progress chart and graphs, which can be used to evaluate the status of a project during execution. Examples of chart and graphs that may be downloaded using the reports module **220** are provided below. As explained above, the reports module **220** can be a simple Web interface realized through a commercially available Web browser, wherein the user enters and/or modifies task information via a Web page.

FIG. **12** is an illustration of a project status graph report **1200** in one embodiment of the present invention. In an embodiment of the present invention, the project status graph report **1200** can be accessed via a Web page over the Web using a Web browser. The graph **1200** depicts the progress of the project showing % buffer consumed on the y-axis **1210** and % chain complete on the x-axis **1212**. The red area **1202** of the graph **1200** indicates that the progress of the project is hampered, the yellow area **1204** of the graph **1200** indicates a warning with regards to the progress of the project and the green area **1206** of the graph **1200** indicates that the progress of the project is occurring as planned. The algorithms of the present invention calculate the current status of the project and plot a point on the graph **1200** representing the current status. The algorithms used to calculate % buffer consumed on the y-axis **1210** and % chain complete on the x-axis **1212** are described in greater detail below.

Graph **1200** shows six points of reference for the project shown in the graph **1200**. Each point marks a place in time in which the progress of the project is plotted. Point **1230** is the first point, marking the beginning of the project. Point **1232** is the second point, showing a setback in the project wherein the % chain complete moved to the negative area and the % buffer consumed has increased. This is due to an instance where the chain upon which the % chain complete calculation is based has increased in length, often due to project uncertainties during project execution. The third point, point **1234**, shows that progress has been made toward completing the chain, but that the % buffer consumed has also increased, placing the point **1234** in the red area **1202**.

The fourth point, point **1236**, shows that progress has been made toward completing the chain, and that the % buffer consumed has decreased, placing the point **1236** in the yellow area **1204**. This shows a buffer gain due to, for example, the early completion of tasks. The fifth point, point **1238**, shows that progress has been made toward completing the chain, but that the % buffer consumed has also increased, placing the point **1238** in the yellow area **1204**. The sixth point, point **1240**, shows that progress has reversed toward completing the chain, and that the % buffer consumed has also increased, placing the point **1240** in the red area **1202**. Once again, this may be due to an instance where the chain upon which the % chain complete calculation is based has increased in length, often due to project uncertainties during execution.

In one example, the % chain complete of the x-axis **1212** is calculated as:

% chain complete=(original critical chain duration−remaining duration of the longest chain)/original critical chain duration

Original critical chain duration is the time needed to complete the longest chain of tasks including planned availability of resources. The remaining duration of the longest chain is the time needed to finish the longest remaining chain of tasks including planned availability of resources at the current time in the project history.

In another example, the % chain complete of the x-axis **1212** is calculated differently for milestone chains, wherein a chain of tasks/projects leads to a project milestone, and feeding chains, wherein a chain of tasks/projects feeds into another set of tasks/projects. In this example, the % chain complete of the x-axis **1212** is calculated as:

% chain complete=(original duration of longest path including activity and resource dependencies on critical chain−remaining duration of the longest path including activity and resource dependencies on critical chain)/original duration of longest path including activity and resource dependencies on critical chain

This calculation takes into account the fact that chains feeding into milestones often change continuously. To account for this phenomena, the milestone chain includes activity dependencies and only resource dependencies on the critical chain.

In another example, the % buffer consumed of the y-axis **1210** is calculated by calculating the consumption of the project buffer by the chain feeding into the buffer. If there are multiple chains feeding into the project buffer, the worst value is taken. Since a project buffer can be consumed by any chain of activities and resource dependencies that are linked to this buffer, the % buffer consumed calculation considers the status of the worst chain (which translates into the highest buffer penetration of all chains feeding into the buffer).

The algorithms of the present invention used to calculate the current status of the project on graph **1200** are advantageous as they take into account the various buffers of the multiple projects and the percentage completed of the multiple projects. This provides a truer representation of the progress of a project, as opposed to viewing only data with respect to one of many projects.

Returning to FIG. **10**, also shown is the provision of task prioritization **1004** during execution of the project. Task prioritization **1004** is a process of the present invention whereby task priorities over multiple projects are calculated. The present invention calculates the task priority for every task of the multitude of projects and thus provides a true multi-project task priority, as the calculation is based on multiple factors such as relative project priority, relative buffer priority, buffer consumption rates and other factors. The calculation of task priorities across multiple projects allows managers to see a complete picture of the entire project and thus see the true priority of a particular task. The calculation of a task priority for a single project shows only a partial priority of a particular task. The method in which task priorities are calculated is described in more detail with reference to FIG. **14** below.

FIG. **13**A is a screenshot of a first task prioritization user interface **1300** in one embodiment of the present invention. The user interface **1300** can be realized as a Web page accessible over the Web by a Web browser. The user interface **1300** shows all tasks for a particular task manager, as indicated in text field **1320**, starting on a particular date, as indicated in text field **1322**, and for a specified period of time, as indicated in text field **1324**. The aforementioned text fields allow for different views of information by selecting various selections in the aforementioned text fields, such as selecting a different task manager in the text field **1320**.

The user interface **1300** shows a list of tasks and, for each task, a task description in column **1306**, a task earliest arrival date in column **1308**, a task status in column **1310**, a remaining duration for the task in column **1312** and a last update date in column **1314**. The user interface **1300** also shows a task priority column **1330** for identifying the priority of the tasks Priority in column **1330** is shown by color. High priority tasks are shown as red, while low priority tasks are shown as green. A review of the user interface **1300** shows that the first task **1332** is high priority as the task priority in column **1330** is marked as red. The user interface **1300** also shows that the upcoming task **1334** is high priority as the task priority in column **1330** is also marked as red. The method in which task priorities are calculated is described in more detail with reference to FIG. **14** below.

As task managers administer the progress of their respective tasks, they can access the user interface **1300** and determine the most important tasks to complete, i.e., those tasks that have the greatest effect on the time and budget goals of the project. This information is then used during the execution of the project to determine where manpower and resources should be allocated.

FIG. **13**B is a screenshot of a second task prioritization user interface **1350** in one embodiment of the present invention. The user interface **1350** can be realized as a Web page accessible over the Web by a Web browser. The user interface **1350** shows all tasks for a particular project manager, as indicated in text field **1370**, starting on a particular date, as indicated in text field **1372**, and for a specified period of time, as indicated in text field **1374**. The aforementioned text fields allow for different views of information by selecting various selections in the aforementioned text fields, such as selecting a different project manager in the text field **1370**.

The user interface **1350** shows a list of tasks and, for each task, a task description in column **1356**, a task earliest arrival date in column **1358**, a task status in column **1360**, a remaining duration for the task in column **1362** and a last update date in column **1364**. The user interface **1350** also shows a task priority column **1380** for identifying the priority of the tasks. Priority in column **1380** is shown by color. High priority tasks are shown as red, medium priority tasks are shown as yellow and low priority tasks are shown as green. A review of the user interface **1350** shows that the first four tasks are high priority as the task priority in column **1380** is marked as red for all four. The method in which task priorities are calculated is described in more detail with reference to FIG. **14** below.

As project managers administer the progress of their respective tasks, they can access the user interface **1350** and determine the most important tasks to complete, i.e., those tasks that have the greatest effect on the time and budget goals of the project. This information is then used during the execution of the project to determine where manpower and resources should be allocated.

FIG. **14** is an operational flow diagram showing the task prioritization calculation process according to one embodiment of the present invention. FIG. **14** shows the method in which task priorities are calculated for the task priority columns **1330** and **1380** for FIGS. **13**A and **13**B, respectively. The operation and control flow of FIG. **14** begins with step **1402** and proceeds directly to step **1404**.

In step **1404**, for each task, all buffers fed by each task are identified. In other words, all task-buffer pairs are identified. In step **1406**, the percent of penetration of each task into a buffer into which it feeds is calculated. I.e., the buffer penetration of each task-buffer pair is calculated. The percent of buffer penetration of any task-buffer pair is equal to the percent of buffer penetration of the chain to which the corresponding task belongs, into the buffer of the task-buffer pair. If the task of the task-buffer pair belongs to multiple chains, the worst buffer penetration value is taken. Also in step **1406**, the percent chain length complete for each task-buffer pair is calculated. Note that this calculation takes the percent chain length complete of the longest chain that has one endpoint at the buffer and contains the task.

In step **1408**, for each task-buffer pair, the color of the task with respect to the buffer is calculated, based on the slope setting. In other words, for each task-buffer pair, the color of the task on the graph **1200** of FIG. **12** is calculated. In step **1410**, the final color of each task is calculated based on a buffer type priority table that maps priority to colors The buffer priority table, which may be user defined, defines the color (red, yellow or green) that corresponds to each priority type. In step **1412**, the operational flow diagram of FIG. **14** stops.

FIG. **16** is an operational flow diagram showing the throughput measurement graphic generation process according to one embodiment of the present invention. The operation and control flow of FIG. **16** begins with step **1602** and proceeds directly to step **1604**.

In step **1604**, the project management server system **102** receives instructions for creating a graphic for measuring throughput in an ongoing project or projects. The instructions may be received via the flow trend module **222**, which in turn can receive the instruction from a user or a pre-programmed entity. The instructions can comprise specifications on the throughput measurements desired, such as the particular project or projects, the particular priority, the particular division, the particular business unit, the particular customer, the particular portfolio, the particular project manager, the particular task manager, the particular task status, the particular resource manager, and a particular resource.

A division is a segment of a company or business association executing a project or projects. A business is a subsegment of a company or business association executing a project or projects. A task priority is the importance level, i.e., priority, (such as low, medium or high) of a task. A customer is a company or individual for which a project or projects is executed. A portfolio is a conglomeration of units or segments of a company or business that are involved in a particular project or projects. A project manager is a manager that is placed in charge of a particular project, while a task manager is a manager that is placed in charge of a particular task. A resource is an expendable or fungible item that is utilized for a task or tasks of a project or projects, while a resource manager is a manager that is placed in charge of a particular resource.

A task status is a task attribute that can be either 1) a task in-progress, i.e., a task that has already begun (also known as a task IP for "In-Progress") or 2) a pending task, i.e., a task that has not already begun (also known as a task NS for "Not Started"). IP tasks or NS tasks that are expected to start in the current time period are referred to as WIP Tasks ("Work in Process") for that time period. A trend of the Work In Process tasks along with the priority of the task is an excellent indicator of throughput. For example, an increasing trend in WIP tasks for a selected resource or task manager indicates that too much work is being planned, A trend of WIP changing from low to high priority, i.e., from green to red, indicates that the work is getting delayed or stuck at a particular resource or task manager. The instructions received by the project management server system **102** for creating a graphic for measuring throughput in an ongoing project or projects can also comprise specifications pertaining to a graphic for depicting the throughput measurements desired. For example, the instructions may define the entire time period for which measurements are desired, the number of sub-periods into which the entire time period shall be divided, the duration of each time period, and the colors to use for the graphic.

In step **1606**, the project management server system **102** generates a list of time periods for a specific project or projects. The list of time periods can be a chronological list of time periods, wherein each time period can be a day, a week, a month, a year or any other discernable period of time. The total era of time represented by the list of time periods can encompass: 1) a specific segment of the lifetime of a project or projects, 2) the total lifetime of a project or projects, or 3) a time-span extending from the beginning of a project or projects to a point in time before the end of the project or projects. The duration of time represented by each time period of the list of time periods can be uniform.

In step **1608**, for each time period of the list of time periods, the project management server system **102** calculates the total number of all tasks (or WIP tasks) that existed for that time period. The project management server system **102** also calculates the priority of each WIP task for that time period. In another embodiment of the present invention, the project management server system **102** further calculates any of the following information for each WIP task for that time period: the particular project or projects pertaining to each task, the particular division pertaining to each task, the particular business unit pertaining to each task, the particular customer pertaining to each task, the particular portfolio pertaining to each task, the particular project manager pertaining to each task, the particular task manager pertaining to each task, the particular task status pertaining to each task, the particular resource manager pertaining to each task, and the particular resource pertaining to each task.

In step **1612**, the project management server system **102** generates a graphic that visually indicates the information that was calculated in step **1608** above. A graphic is a computer readable group of data that, when read by an appropriate computer component, can be displayed on a flat panel display, a monitor or a cathode ray tube. An example of a graphic can be a JPEG file that is stored or transmitted for reading by a computer and display on a monitor. The graphic of step **1612** comprises a chart, a spreadsheet or a graph that visually indicates numerical or other information. The graphic may comprise a bar chart, a pie chart, a linear graph or a three dimensional graph.

In one embodiment of the present invention, the project management server system **102** generates a graphic comprising a vertical bar chart wherein a vertical bar is generated for each time period of the list of time periods. Along the x-axis of the bar chart, time periods are depicted. Along the y-axis of the bar chart, a number of WIP tasks is indicated. The length of each bar represents the number of WIP tasks for that time period, as calculated in step **1608** above. The bar can further be broken down or segmented into separate segments using, for example, colors or horizontal lines. The segments are used to indicate the priority of each WIP task for that time period. That is, each segment represents the number of WIP tasks in that time period with a given priority. For example, red may be used for a first segment to indicate the number of high priority tasks, yellow may be used for a second segment to indicate the number of medium priority tasks, and green may be used for a third segment to indicate the number of low priority tasks. Examples of the graphic of step **1612** are provided below with reference to FIGS. **18-29**.

In optional step **1614**, the project management server system **102** modifies the graphic to visually indicate additional information that was calculated in step **1608**. In one embodiment of the present invention, the project management server system **102** modifies the graphic by modifying the vertical bar that is generated for each time period of the list of time periods. Each bar can further be broken down or segmented into separate segments to indicate additional information for each time period, such as: the number of tasks pertaining to each project or projects, the number of tasks pertaining to each division, the number of tasks pertaining to each business unit, the number of tasks pertaining to each customer, the number of tasks pertaining to each portfolio, the number of tasks pertaining to each project manager, the number of tasks pertaining to each task manager, the number of tasks pertaining to each task status, the number of tasks pertaining to each resource manager, and the number of tasks pertaining to each resource.

In one optional step, the project management server system **102** modifies the graphic to visually indicate additional information. In one embodiment of the present invention, the project management server system **102** generates an additional vertical bar for each time period of the list of time periods. Each vertical bar indicates the number of IP tasks for that time period. That is, the length of each bar represents the number of IP tasks for that time period. The bar can further be broken down or segmented into separate segments using, for example colors or horizontal lines. The segments are used to indicate the priority of each IP task for that time period. That is, each segment represents the number of IP tasks in that time period with a given priority.

In another optional step, the project management server system **102** modifies the graphic to visually indicate additional information. In one embodiment of the present invention, the project management server system **102** modifies the graphic by modifying the vertical bar (of the optional step above) that is generated for each time period of the list of time periods. Each vertical bar can further be broken down or segmented into separate segments to indicate additional information for each time period, such as: the number of tasks pertaining to each project or projects, the number of tasks pertaining to each division, the number of tasks pertaining to each business unit, the number of tasks pertaining to each customer, the number of tasks pertaining to each portfolio, the number of tasks pertaining to each project manager, the number of tasks pertaining to each task manager, the number of tasks pertaining to each task status, the number of tasks pertaining to each resource manager, and the number of tasks pertaining to each resource.

In step **1620**, the graphic is provided to a user of the project management server system **102**. In one embodiment of the present invention, the graphic is directly provided to a monitor that subsequently displays the graphic to the user. In another embodiment of the present invention, the graphic is provided to a client, such as the flow trend client **222**, on a computer of a user via a network, such as network **104** or a WAN. The graphic is then displayed on a monitor of the user computer. In step **1622**, the control flow of FIG. **16** stops.

FIG. **17** is an operational flow diagram showing another throughput measurement graphic generation process according to another embodiment of the present invention. The operation and control flow of FIG. **17** begins with step **1702** and proceeds directly to step **1704**.

In step **1704**, the project management server system **102** receives instructions for creating a graphic for measuring throughput in an ongoing project or projects. The instructions of step **1704** are similar or identical to the instructions of step **1604** above. In step **1706**, the project management server system **102** generates a list of time periods for a specific project or projects, similar to step **1606** above.

In step **1708**, for each time period of the list of time periods, the project management server system **102** calculates the total number of resource units that existed for that time period. The project management server system **102** also calculates the priority of each resource for that time period. In another embodiment of the present invention, the project management server system **102** further calculates any of the following information for each resource for that time period: the particular project or projects pertaining to each resource, the particular division pertaining to each resource, the particular business unit pertaining to each resource, the particular customer pertaining to each resource, the particular portfolio pertaining to each resource, the particular project manager pertaining to each resource, and the particular resource manager pertaining to each resource.

In step **1710**, the project management server system **102** calculates the load on resources assigned to WIP tasks for each time period of the list of time periods. In step **1712**, the project management server system **102** generates a graphic that visually indicates the information that was calculated in steps **1708**-**1710** above. The graphic of step **1712** is similar to the graphic of step **1612** above.

In one embodiment of the present invention, the project management server system **102** generates a graphic comprising a vertical bar chart wherein a vertical bar is generated for each time period of the list of time periods, similar to step **1612** above. Along the x-axis of the bar chart, time periods are depicted. Along the y-axis of the bar chart, a number of resource units is indicated. The length of each bar represents the resource load exacted by tasks for that time period, as calculated in steps **1708**-**1710** above. The bar can further be broken down or segmented into separate segments using, for example, colors or horizontal lines. The segments are used to indicate the priority of each tasks for that time period. That is, each segment represents the number of tasks in that time period with a given priority. Examples of the graphic of step **1712** are provided below with reference to FIGS. **18**-**29**.

In optional step **1714**, the project management server system **102** modifies the graphic to visually indicate additional information that was calculated in steps **1708**-**1710**. In one embodiment of the present invention, the project management server system **102** modifies the graphic by modifying the vertical bar that is generated for each time period of the list of time periods. Each bar can further be broken down or segmented into separate segments to indicate additional information for each time period, such as: the number of resources pertaining to each project or projects, the number of resources pertaining to each division, the number of resources pertaining to each business unit, the number of resources pertaining to each customer, the number of resources pertaining to each portfolio, the number of resources pertaining to each project manager, and the number of resources pertaining to each resource manager.

In step **1720**, the graphic is provided to a user of the project management server system **102**, similar to step **1620** above. In step **1722**, the control flow of FIG. **17** stops.

FIG. **18** is a screenshot of a user interface **1800** showing a throughput measurement graphic in one embodiment of the present invention. The user interface **1800** is used for visually indicating throughput measurements to a user, as described in greater detail below. The user interface **1800** can be realized as a Web page accessible over the Web by a Web browser or as a graphical object that is imply displayed on a monitor. The user interface **1800** shows a bar graph indicating the number of tasks for each of a list of time period, and the priority of each task in that time period. Pull down menus and other interface widgets of the user interface **1800** allow for different views of information, as described in the additional figures below.

The user interface **1800** shows a vertical bar chart **1802** wherein a vertical bar is generated for each time period of a list of time periods. Along the x-axis **1804** of the bar chart **1802**, time periods **1806** are depicted. Along the y-axis **1808** of the bar chart **1802**, a total number of tasks (i.e., WIP tasks) is indicated by the length of each bar **1810**. The length of each bar **1810** represents the number of WIP tasks for that time period (for example, as calculated in step **1608** above). Each bar is further broken down into separate segments using colors or horizontal lines. The segments are used to show the number of WIP tasks in that time period with a given priority. For example, bar **1812** shows a first segment **1814** that indicates the number of high priority tasks, and a second segment **1816** that indicates the number of low priority tasks. The almost equal length of segment **1814** and segment **1816** indicates that there was an almost equal number of high priority and low priority tasks during the time period starting Jan. 3, 2005. The length of bar **1812** indicates that a total of about eighteen tasks exist for the period starting Jan. 3, 2005.

The user interface **1800** further shows a set of interface widgets **1811**, indicated by a "Filter By" text. The set of interface widgets **1811** are used for specifying restraints that are reflected in the bar chart **1802**. The pull down menu **1820** is used to filter the bar chart **1802** by division, and it is currently selected to "All Divisions" such that all tasks for all divisions are considered for the calculations reflected in the bars of bar chart **1802**. Individual divisions can be selected from pull down menu **1820** such that only the tasks for the selected division are considered for the calculations reflected in the bars of bar chart **1802**. The pull down menu **1822** is used to filter the bar chart **1802** by portfolio, and it is currently selected to "All Portfolios" such that all tasks for all portfolios are considered for the calculations reflected in the bars of bar chart **1802**. Individual portfolios can be selected from pull down menu **1822** such that only the tasks for the selected portfolios are considered for the calculations reflected in the bars of bar chart **1802**.

The pull down menu **1824** is used to filter the bar chart **1802** by business unit, and it is currently selected to "All Business Units" such that all tasks for all business units are considered for the calculations reflected in the bars of bar chart **1802**. Individual business units can be selected from pull down menu **1824** such that only the tasks for the selected business unit are considered for the calculations reflected in the bars of bar chart **1802**. The pull down menu **1826** is used to filter the bar chart **1802** by customer, and it is currently selected to "All Customers" such that all tasks for all customers are considered for the calculations reflected in the bars of bar chart **1802**. Individual customers can be selected from pull down menu **1826** such that only the tasks for the selected customers are considered for the calculations reflected in the bars of bar chart **1802**.

The pull down menu **1828** is used to filter the bar chart **1802** by projects, and it is currently selected to "All Projects" such that all tasks for all projects are considered for the calculations reflected in the bars of bar chart **1802**. Individual projects can be selected from pull down menu **1828** such that only the tasks for the selected projects are considered for the calculations reflected in the bars of bar chart **1802**. The pull down menu **1830** is used to filter the bar chart **1802** by project manager, and it is currently selected to "All Project Managers" such that all tasks for all project managers are considered for the calculations reflected in the bars of bar chart **1802**. Individual project managers can be selected from pull down menu **1830** such that only the tasks for the selected project managers are considered for the calculations reflected in the bars of bar chart **1802**.

The pull down menu **1832** is used to filter the bar chart **1802** by task manager, and it is currently selected to "All Task Managers" such that all tasks for all task managers are considered for the calculations reflected in the bars of bar chart **1802**. Individual task managers can be selected from pull down menu **1832** such that only the tasks for the selected task manager are considered for the calculations reflected in the bars of bar chart **1802**. The pull down menu **1834** is used to filter the bar chart **1802** by task status, and it is currently selected to "All Status" such that all tasks of all task statuses are considered for the calculations reflected in the bars of bar chart **1802**. Individual task statuses can be selected from pull down menu **1834** such that only the tasks for the selected task status are considered for the calculations reflected in the bars of bar chart **1802**. As indicated above, there are three task status values: WIP tasks, NS tasks and IP tasks. A selection of "All Status" from pull down menu **1834** indicates a selection of all or WIP tasks, a selection of "NS tasks" indicates tasks that have not been started yet, and a selection of "IP tasks" indicates tasks that are currently in-progress or have already started.

The pull down menu **1836** is used to filter the bar chart **1802** by priority, and it is currently selected to "All Priorities" such that all tasks of all priorities are considered for the calculations reflected in the bars of bar chart **1802**. Individual priorities can be selected from pull down menu **1836** such that only the tasks for the selected priority are considered for the calculations reflected in the bars of bar chart **1802**. As indicated above, there are three task priority values: red (or high priority) tasks, yellow (or medium priority) tasks and green (or low priority) tasks. A selection of "Red" from pull down menu **1836** indicates a selection of red priority tasks, a selection of "Yellow" indicates a selection of yellow priority tasks, and a selection of "Green" indicates a selection of green priority tasks.

The pull down menu **1838** is used to filter the bar chart **1802** by resource manager, and it is currently selected to "All Resource Managers" such that all tasks for all resource managers are considered for the calculations reflected in the bars of bar chart **1802**. Individual resource managers can be selected from pull down menu **1838** such that only the tasks for the selected resource managers are considered for the calculations reflected in the bars of bar chart **1802**.

The pull down menu **1840** is used to filter the bar chart **1802** by resource, and it is currently selected to "All Resources" such that all tasks for all resources are considered for the calculations reflected in the bars of bar chart **1802**. Individual resources can be selected from pull down menu **1840** such that only the tasks for the selected resource are considered for the calculations reflected in the bars of bar chart **1802**. Radio buttons **1842** allow a user to select a time period duration by selecting either "weeks" or "months" and further entering a number into the text field **1844**. These widgets are currently set at 24 weeks.

The pull down menu **1845** is used to indicate the breakdown or segmentation of the bars **1810** of the bar chart **1802**. Menu **1845** is currently selected to "Priority" such each bar **1810** is segmented into separate segments indicating the number of tasks in that time period that held each priority value. Other breakdown attributes can be selected from pull down menu **1845** such that each bar **1810** is segmented into separate segments indicating the number of tasks in that time period that possess the selected attribute. Other breakdown attributes that can be selected from pull down menu **1845** include: task division, task portfolio, task business unit, task project, task project manager, task manager, task status, task priority, task resource manager and task resource.

FIG. **18** further includes a button **1846** including a "Create Chart" text. Once the appropriate selections are made by the user from the other widgets of interface **1811**, the user can press the button **1846** to generate the bar chart **1802** that reflects his selections. Alternatively, the user can select the check box **1848** and subsequently press the button **1846** so as to create two separate bar charts depicting two separate data specifications. Examples of such a bar chart are shown with reference to FIGS. **20** and **21** below.

The user interface **1800** is used by managers or division heads to manage projects within the project management server system **102** during the course of a project or projects. The user interface **1800** provides the advantage of allowing for quick and easy generation of bar charts that visually indicate the throughput of a system, allows a user to breakdown throughput measurements by status and priorities, and allow the user to measure throughput at various levels of an organization. This allows a user, such as a manager or a division head, to identify when queues are building up, thereby creating longer wait times, and identify bottlenecks or opportunities to increase throughput of the system. For example, an increasing trend of high priority tasks above available capacity high priority tasks indicates that work is getting stuck or delayed at a bottleneck, causing throughput to decrease. This allows for corrective action to be taken at a local level—at the bottleneck.

FIG. **19** is a screenshot of another user interface **1900** showing a throughput measurement graphic in one embodiment of the present invention. Like user interface **1800**, user interface **1900** is used for visually indicating throughput measurements to a user, as described in greater detail below. The user interface **1900** shows a bar graph indicating the resource load (measured in resource units) for the tasks pertaining to each of a list of time periods, and the priority of the tasks pertaining to each time period. Pull down menus and other interface widgets of the user interface **1900** allow for different views of information, as described in the additional figures below.

The user interface **1900** shows a vertical bar chart **1902** wherein a vertical bar is generated for each time period of a list of time periods. Along the x-axis **1904** of the bar chart **1902**, time periods **1906** are depicted. Along the y-axis **1908** of the bar chart **1902**, a total number of resource units are indicated by the length of each bar **1910**. The length of each bar **1910** represents the number of resource units representing the resource load of the tasks for that time period (for example, as calculated in step **1708** above). Each bar is further broken down into separate segments using colors or horizontal lines. The segments are used to show the number of tasks in that time period with a given priority. For example, bar **1912** shows a first segment **1914** that indicates the number of high priority tasks, and a second segment **1916** that indicates the number of low priority tasks. The almost equal length of segment **1914** and segment **1916** indicates that there was an almost equal number of high priority and low priority tasks during the time period starting Jan. 3, 2005. The length of bar **1912** indicates that about eighteen resource units represent the resource load for the tasks for the time period starting Jan. 3, 2005. The user interface **1900** further shows a set of interface widgets **1911**, similar to those of interface **1800**.

FIG. **20** is a screenshot of yet another user interface **2000** showing a throughput measurement graphic in one embodiment of the present invention. Like user interface **1800**, the user interface **2000** is used for visually indicating throughput measurements to a user. The user interface **2000** shows a bar graph indicating the number of tasks for each of a list of time periods, and the priority of each task in that time period. Pull down menus and other interface widgets of the user interface **2000** allow for different views of information, as described in the additional figures below.

The user interface **2000** shows a vertical bar chart **2002** (similar to the bar chart **1802** of FIG. **18**) wherein two vertical bars are generated for each time period of a list of time periods. Along the x-axis **2004** of the bar chart **2002**, time periods **2006** are depicted. Along the y-axis **2008** of the bar chart **2002**, a total number of tasks (i.e., WIP tasks) is indicated by the length of each left side bar and a total number of IP tasks is indicated by the length of each right side bar. Each bar is further broken down into separate segments using colors or horizontal lines. The segments are used to show the number of tasks in that time period with a given priority. The user interface **1800** further shows a set of interface widgets **2011** similar to the set of widgets **1811** of FIG. **18**.

FIG. **20** further includes a button **2046** including a "Create Chart" text. Once the appropriate selections are made by the user from the other widgets of interface **2002**, the user can press the button **2046** to generate the bar chart **2002** that reflects his selections. Then, the user can select the check box **2048** and subsequently press the button **2046** so as to create two separate bar charts depicting two separate data specifications. FIG. **20**, for example, shows two vertical bars for each time period, wherein the left side bar represents the WIP tasks for the time period and the right side bar represents the IP tasks for the time period. In short, user interface **2000** can be used to compare the throughput of WIP Tasks with the throughput of IP tasks, using the side-by-side arrangement of the two bars for each time period. A comparison of the high priority (red and yellow) NS and IP tasks with WIP tasks indicates if priorities are being followed and tasks are being started based on the priorities.

FIG. **21** is a screenshot of the user interface **2000** of FIG. **20** after an additional selection has been made. User interface **2000** shows the result of selecting the "Red" selection from the priority pull down menu **2036**. User interface **2000** shows a vertical bar chart **2002** wherein two vertical bars are generated for each time period of a list of time periods. A total number of tasks (i.e., WIP tasks) is indicated by the length of each left side bar and a total number of IP tasks is indicated by the length of each right side bar. Each bar is further broken down into separate segments using colors or horizontal lines. The segments are used to show the number of tasks in that time period with a given priority. The act of selecting the "Red" selection from the priority pull down menu **2036** results in the right side bar being limited to "Red" or high priority tasks, consequently, each right side bar comprises only one segment, indicating all "Red" tasks.

In short, user interface **2000** of FIG. **21** can be used to compare the throughput of WIP Tasks with the throughput of high priority IP tasks, using the side-by-side arrangement of the two bars for each time period.

FIG. **22** is a screenshot of the user interface **2000** of FIG. **21** after an additional selection has been made. User interface **2000** shows the result of selecting the "Task Manager" selection from the breakdown pull down menu **2045**. User interface **2000** shows a vertical bar chart **2002** wherein one vertical bar is generated for each time period of a list of time periods. A total number of IP tasks is indicated by the length of each bar (see selection of "IP" in task status pull down menu **2034**). Each bar is further broken down into separate segments using colors or horizontal lines. The segments are used to show the number of tasks in that time period that correspond to a particular task manager. The act of selecting the "Task Manager" selection from the breakdown pull down menu **2045** results in each bar being broken down into separate segments, wherein each segment represents a separate task manager. The legend **2022** on the right side of the bar chart **2002** explains the different shading or color of each segment.

In short, user interface **2000** of FIG. **22** can be used to view the distribution of high priority IP tasks among task managers, using segmented bars for each time period.

FIG. **23** is a screenshot of the user interface **2000** of FIG. **22** after additional selections have been made. User interface **2000** shows the result of 1) returning the breakdown pull down menu **2045** to the "Priority" selection, and 2) selecting a particular task manager—Jim—from the task manager pull down menu **2032**. User interface **2000** shows a vertical bar chart **2002** wherein one vertical bar is generated for each time period of a list of time periods. A total number of WIP tasks is indicated by the length of each bar (see selection of "All Status" in task status pull down menu **2034**). Each bar is not broken down into separate segments since only one priority is selected from the priority pull down menu **2036**—"Red" is selected. Thus, only high level priority tasks are counted for the bars in the bar chart **2002**. The act of selecting the "Jim" selection from the task manager pull down menu **2032** results in each bar representing only those tasks that pertain to the particular task manager for each time period.

In short, user interface **2000** of FIG. **23** can be used to view the amount of high priority WIP tasks assigned to a particular task manager.

FIG. **24** is a screenshot of the user interface **2000** of FIG. **23** after an additional selection has been made. User interface **2000** shows the result of selecting the "Red" selection from the priority pull down menu **2036**. User interface **2000** shows a vertical bar chart **2002** wherein two vertical bars are generated for each time period of a list of time periods. A total number of tasks (i.e., WIP tasks) is indicated by the length of each left side bar and a total number of IP tasks is indicated by the length of each right side bar. Each bar is not broken down into separate segments since only one priority is selected from the priority pull down menu **2036**—"Red" is selected. Thus, only high level priority tasks are counted for the bars in the bar chart **2002**.

In short, user interface **2000** of FIG. **24** can be used to compare the amount of high priority WIP tasks assigned to a particular task manager with the amount of high priority IP tasks assigned to the same task manager.

FIG. **25** is a screenshot of the user interface **2000** of FIG. **24** after additional selections have been made. User interface **2000** shows the result of selecting the "Projects" selection from the breakdown pull down menu **2045**. Further, the priority pull down menu **2036** has been returned to the "All Priorities" selection. User interface **2000** shows a vertical bar chart **2002** wherein one vertical bar is generated for each time period of a list of time periods. A total number of WIP tasks is indicated by the length of each bar (see selection of "All Status" in task status pull down menu **2034**). Each bar is further broken down into separate segments using colors or horizontal lines. The segments are used to show the number of tasks in that time period that correspond to a particular projects. The act of selecting the "Projects" selection from the breakdown pull down menu **2045** results in each bar being broken down into separate segments, wherein each segment represents a separate project. The legend **2022** on the right side of the bar chart **2002** explains the different shading or color of each segment.

In short, user interface **2000** of FIG. **25** can be used to view the amount of WIP tasks assigned to a particular task manager, wherein the tasks are broken down by particular projects.

FIG. **26** is a screenshot of the user interface **2000** of FIG. **25** after additional selections have been made. User interface **2000** shows the result of selecting the "NS" selection from the task status pull down menu **2034**. Further, the priority pull down menu **2036** has been returned to the "Red" selection. User interface **2000** shows a vertical bar chart **2002** wherein one vertical bar is generated for each time period of a list of time periods. A total number of NS tasks is indicated by the length of each bar (see selection of "NS" in task status pull down menu **2034**). Each bar is further broken down into separate segments representing separate projects for the selected task manager for the time period. The legend **2022** on the right side of the bar chart **2002** explains the different shading or color of each segment.

In short, user interface **2000** of FIG. **26** can be used to view the amount of high priority NS tasks assigned to a particular task manager, wherein the tasks are broken down by particular projects.

FIG. **27** is a screenshot of the user interface **2000** of FIG. **24** after additional selections have been made. User interface **2000** shows the result of selecting a project from the project pull down menu **2028**, selecting the "All Status" selection from the task status pull down menu **2034** and selecting "Task Status" from the breakdown pull down menu **2045**. User interface **2000** shows a vertical bar chart **2002** wherein one vertical bar is generated for each time period of a list of time periods. A total number of WIP tasks for the selected project is indicated by the length of each bar (see selection of "All Status" in task status pull down menu **2034**). Each bar is broken down into separate segments representing separate task statuses for the selected task manager for the time period, however since this particular task manager possesses only "NS" status tasks for the selected project, it is shown that each bar comprises only one segment. The legend **2022** on the right side of the bar chart **2002** explains the different shading or color of each segment.

In short, user interface **2000** of FIG. **27** can be used to view the amount of high priority WIP tasks assigned to a particular task manager for a particular project, wherein the tasks are broken down by particular task statuses.

FIG. **28** is a screenshot of another user interface showing a throughput measurement graphic in one embodiment of the present invention. Like user interface **1900**, user interface **2800** is used for visually indicating throughput measurements to a user. The user interface **2800** shows a bar chart **2802** indicating the resource load (measured in resource units) for the tasks that pertain to each of a list of time periods, and the priority of each task in that time period. FIG. **28** shows that two bars are present for each time period. The first left-side bar for each time period represents the resource load for the all tasks (i.e., WIP tasks or Work-In-Process tasks) for the time period. The second right-side bar for each time period represents the resource load for IP tasks (or In-Progress tasks) for the time period. Each bar is broken down into separate segments representing the priorities for the group of tasks pertaining to each time period. The legend **2822** on the right side of the bar chart **2802** explains the different shading or color of each segment. In short, user interface **2800** of FIG. **28** can be used to compare the resource load of all resources with the resource load of a particular resource.

FIG. **29** is a screenshot of the user interface **2800** of FIG. **28** after additional selections have been made. User interface **2800** shows the result of selecting a resource from the resource pull down menu **2940**, selecting a project from the breakdown pull down menu **2928** and reducing the bar chart to one bar per time period. The bar for each time period is separated into different segments, wherein each segment represents a different project and wherein the segments indicate how much of the resource load for each time period is attributed to each project. The horizontal line **2950** in the bar chart **2802** shows a resource load threshold indicator that indicates the amount of resource load that can be supported by the available resources for a group of tasks pertaining to each time period. In short, user interface **2800** of FIG. **29** can be used to view the resource load (broken down by particular projects) for different time periods, in addition to viewing a resource load threshold indicator.

The present invention can be realized in hardware, software, or a combination of hardware and software in the system described in FIG. **2**. A system according to a preferred embodiment of the present invention can be realized in a centralized fashion in one computer system, or in a distributed fashion where different elements are spread across several interconnected computer systems. Any kind of computer system—or other apparatus adapted for carrying out the methods described herein—is suited. A typical combination of hardware and software could be a general-purpose computer system with a computer program that, when being loaded and executed, controls the computer system such that it carries out the methods described herein.

An embodiment of the present invention can also be embedded in a computer program product, which comprises all the features enabling the implementation of the methods described herein, and which—when loaded in a computer system—is able to carry out these methods. Computer program means or computer program as used in the present invention indicates any expression, in any language, code or notation, of a set of instructions intended to cause a system having an information processing capability to perform a particular function either directly or after either or both of the following a) conversion to another language, code or, notation; and b) reproduction in a different material form.

A computer system may include, inter alia, one or more computers and at least a computer readable medium, allowing a computer system, to read data, instructions, messages or message packets, and other computer readable information from the computer readable medium. The computer readable medium may include non-volatile memory, such as ROM, Flash memory, Disk drive memory, CD-ROM, and other permanent storage. Additionally, a computer readable medium may include, for example, volatile storage such as RAM, buffers, cache memory, and network circuits. Furthermore, the computer readable medium may comprise computer readable information in a transitory state medium such as a network link and/or a network interface, including a wired network or a wireless network, that allow a computer system to read such computer readable information.

FIG. **15** is a block diagram of a computer system useful for implementing an embodiment of the present invention. The computer system of FIG. **15** is a more detailed representation of computers **106** through **108** or system **102**. The computer system of FIG. **15** includes one or more processors, such as processor **1504**. The processor **1504** is connected to a communication infrastructure **1502** (e.g., a communications bus, cross-over bar, or network). Various software embodiments are described in terms of this exemplary computer system. After reading this description, it will become apparent to a person of ordinary skill in the relevant art(s) how to implement the invention using other computer systems and/or computer architectures.

The computer system can include a display interface **1508** that forwards graphics, text, and other data from the communication infrastructure **1502** (or from a frame buffer not shown) for display on the display unit **1510**. The computer system also includes a main memory **1506**, preferably random access memory (RAM), and may also include a secondary memory **1512**. The secondary memory **1512** may include, for example, a hard disk drive **1514** and/or a removable storage drive **1516**, representing a floppy disk drive, a magnetic tape drive, an optical disk drive, etc. The removable storage drive **1516** reads from and/or writes to a removable storage unit **1518** in a manner well known to those having ordinary skill in the art. Removable storage unit **1518**, represents, for example, a floppy disk, magnetic tape, optical disk, etc. which is read by and written to by removable storage drive **1516**. As will be appreciated, the removable storage unit **1518** includes a computer usable storage medium having stored therein computer software and/or data.

In alternative embodiments, the secondary memory **1512** may include other similar means for allowing computer programs or other instructions to be loaded into the computer system. Such means may include, for example, a removable storage unit **1522** and an interface **1520**. Examples of such may include a program cartridge and cartridge interface (such as that found in video game devices), a removable memory chip (such as an EPROM, or PROM) and associated socket, and other removable storage units **1522** and interfaces **1520** which allow software and data to be transferred from the removable storage unit **1522** to the computer system.

The computer system may also include a communications interface **1524**. Communications interface **1524** allows software and data to be transferred between the computer system and external devices. Examples of communications interface **1524** may include a modem, a network interface (such as an Ethernet card), a communications port, a PCMCIA slot and card, etc. Software and data transferred via communications interface **1524** are in the form of signals which may be, for example, electronic, electromagnetic, optical, or other signals capable of being received by communications interface **1524**. These signals are provided to communications interface **1524** via a communications path (i.e., channel) **1526**. This channel **1526** carries signals and may be implemented using wire or cable, fiber optics, a phone line, a cellular phone link, an RF link, and/or other communications channels.

In this document, the terms "computer program medium," "computer usable medium," and "computer readable medium" are used to generally refer to media such as main memory **1506** and secondary memory **1512**, removable storage drive **1516**, a hard disk installed in hard disk drive **1514**, and signals. These computer program products are means for providing software to the computer system. The computer readable medium allows the computer system to read data, instructions, messages or message packets, and other computer readable information from the computer readable medium. The computer readable medium, for example, may include non-volatile memory, such as Floppy, ROM, Flash memory, Disk drive memory, CD-ROM, and other permanent storage. It is useful, for example, for transporting information, such as data and computer instructions, between computer systems. Furthermore, the computer readable medium may comprise computer readable information in a transitory state medium such as a network link and/or a network interface, including a wired network or a wireless network, that allow a computer to read such computer readable information.

Computer programs (also called computer control logic) are stored in main memory **1506** and/or secondary memory **1512**. Computer programs may also be received via communications interface **1524**. Such computer programs, when executed, enable the computer system to perform the features of the present invention as discussed herein. In particular, the computer programs, when executed, enable the processor **1504** to perform the features of the computer system. Accordingly, such computer programs represent controllers of the computer system.

Although specific embodiments of the invention have been disclosed, those having ordinary skill in the art will understand that changes can be made to the specific embodiments without departing from the spirit and scope of the invention. The scope of the invention is not to be restricted, therefore, to the specific embodiments. Furthermore, it is intended that the appended claims cover any and all such applications, modifications, and embodiments within the scope of the present invention.

What is claimed is:

1. A method executed on a computer for providing critical chain-based project management, comprising:

generating a plurality of project plans having a critical chain, each of the plurality of project plans corresponding to one of a plurality of projects, wherein a project comprises a plurality of tasks;

generating buffers, blocks of unscheduled time, for each of the plurality of projects, wherein at least one of the buffers generated is placed on the critical chain;

reconciling project resources among the plurality of projects such that priority is given to resource needs of the critical chain;

executing the plurality of project plans;

generating a list of sequential time periods for a project of the plurality of projects;

calculating a number of tasks for each time period of the generated list of sequential time periods;

generating a graphic that visually indicates the number of tasks for each time period and a priority of each task of the number of tasks for each time period;

providing the graphic to a user via a graphical user interface; and

continuously modifying a priority of any task of the number of tasks based on a project buffer consumption percentage of a longest chain to which the task belongs and based on a chain completion percentage of the longest chain to which the task belongs, wherein the priority of the task is calculated across the plurality of projects so as to accommodate the critical chain.

2. The method of claim **1**, wherein the first step of generating a list comprises:

generating a list of sequential time periods for the project, wherein each time period comprises any one of: a day, a week, a month, and a year.

3. The method of claim **1**, wherein the step of calculating a number comprises:

calculating a number of tasks for each time period and reading at least one of the following for each task:

a priority of the task;
a division of the task;
a portfolio of the task;
a business unit of the task;
a project of the task;
a customer of the task;
a project manager of the task;
a task manager of the task; and
a status of the task.

4. The method of claim 3, wherein the step of generating a graphic comprises:

generating a graphic that visually indicates the number of tasks for each time period and at least one of the following for each task for each time period:

a priority;
a division;
a portfolio;
a business unit;
a project;
a customer;
a project manager;
a task manager; and
a status.

5. The method of claim 4, wherein the step of generating a graphic further comprises:

generating a bar graph including a bar for each time period, wherein each bar visually indicates the number of tasks for each time period and at least one of the following for each task for each time period:

a priority;
a division;
a portfolio;
a business unit;
a project;
a customer;
a project manager;
a task manager; and
a status.

6. The method of claim 5, wherein the step of providing the graphic comprises:

providing the bar graph to a user via a network connection.

7. The method of claim 1, wherein the step of generating a graphic further comprises:

generating a bar graph including a bar for each time period, wherein each bar visually indicates the number of tasks for each time period and a priority of each task for each time period.

8. The method of claim 7, wherein the step of providing the graphic comprises:

providing the bar graph to a user via a network connection.

9. A method executed on a computer for providing critical chain-based project management, comprising:

generating a plurality of project plans having a critical chain, each of the plurality of project plans corresponding to one of a plurality of projects, wherein a project comprises a plurality of tasks;

generating buffers, blocks of unscheduled time, for each of the plurality of projects, wherein at least one of the buffers generated is placed on the critical chain;

reconciling project resources among the plurality of projects such that priority is given to resource needs of the critical chain;

executing the plurality of project plans;

generating a list of sequential time periods for a project of the plurality of projects, wherein a task is either in-progress or pending;

calculating a number of in-progress and pending tasks for each time period of the generated list of sequential time periods;

generating a first graphic that visually indicates a number of in-progress tasks for each time period and a priority of each in-progress task for each time period;

generating a second graphic that visually indicates a number of pending tasks for each time period and a priority of each pending tasks for each time period;

providing the first and second graphic to a user via a graphical user interface, wherein the first graphic is displayed juxtaposed to the second graphic so as to visually convey a comparison between the first and second graphic; and

continuously modifying a priority of any task of the number of tasks based on a project buffer consumption percentage of a longest chain to which the task belongs and based on a chain completion percentage of the longest chain to which the task belongs, wherein the priority of the task is calculated across the plurality of projects so as to accommodate the critical chain.

10. The method of claim 9, wherein the first step of generating a list comprises:

generating a list of sequential time periods for the project, wherein each time period comprises any one of: a day, a week, a month, and a year.

11. The method of claim 9, wherein the step of calculating a number comprises:

calculating a number of in-progress and pending tasks for each time period and reading at least one of the following for each task:

a priority of the task;
a division of the task;
a portfolio of the task;
a business unit of the task;
a project of the task;
a customer of the task;
a project manager of the task;
a task manager of the task; and
a status of the task.

12. The method of claim 11, wherein the step of generating comprises:

generating a first graphic that visually indicates a number of in-progress tasks for each time period and at least one of the following for each in-progress tasks for each time period:

a priority;
a division;
a portfolio;
a business unit;
a project;
a customer;
a project manager;
a task manager; and
a status.

13. The method of claim 12, wherein the step of generating comprises:

generating a second graphic that visually indicates a number of pending tasks for each time period and at least one of the following for each pending task for each time period:

a priority;
a division;
a portfolio;
a business unit;
a project;
a customer;
a project manager;
a task manager; and
a status.

14. The method of claim 9, wherein the step of generating further comprises:

generating a bar graph including a bar for each time period, wherein each bar visually indicates the number of in-progress tasks for each time period and at least one of the following for each in-progress task for each time period:

a priority;

a division;
a portfolio;
a business unit;
a project;
a customer;
a project manager;
a task manager; and
a status.

15. The method of claim **14**, wherein the step of generating further comprises:

modifying the bar graph to include an additional bar for each time period, wherein each bar visually indicates the number of pending tasks for each time period and at least one of the following for each pending task for each time period:
a priority;
a division;
a portfolio;
a business unit;
a project;
a customer;
a project manager;
a task manager; and
a status.

16. The method of claim **15**, wherein the step of providing the first and second graphic comprises: providing the bar graph to a user via a network connection.

17. A computer system for providing critical chain-based project management, comprising:

a database for storing project plans for a project comprising a plurality of tasks;
a processor configured for:
generating a plurality of project plans having a critical chain, each of the plurality of project plans corresponding to one of a plurality of projects;
generating buffers, blocks of unscheduled time, for each of the plurality of projects, wherein at least one of the buffers generated is placed on the critical chain;
reconciling project resources among the plurality of projects such that priority is given to resource needs of the critical chain;
executing the plurality of project plans;
generating a list of sequential time periods for a project of the plurality of projects;
calculating a number of tasks for each time period of the generated list of sequential time periods; and
generating a graphic that visually indicates the number of tasks for each time period and a priority of each task of the number of tasks for each time period;
a graphical user interface for providing the graphic to a user; and
continuously modifying a priority of any task of the number of tasks based on a project buffer consumption percentage of a longest chain to which the task belongs and based on a chain completion percentage of the longest chain to which the task belongs, wherein the priority of the task is calculated across the plurality of projects so as to accommodate the critical chain.

18. The computer system of claim **17**, wherein the computer system comprises:

a computer system for providing critical chain-based project management across a plurality of projects for multiple users.

19. The computer system of claim **18**, wherein the graphical user interface is provided over a network, such as a WAN.

20. A method executed on a computer for providing critical chain-based project management, comprising:

generating a plurality of project plans having a critical chain, each of the plurality of project plans corresponding to one of a plurality of projects, wherein a project comprises a plurality of tasks;
generating buffers, blocks of unscheduled time, for each of the plurality of projects, wherein at least one of the buffers generated is placed on the critical chain;
reconciling project resources among the plurality of projects such that priority is given to resource needs of the critical chain;
executing the plurality of project plans;
generating a list of sequential time periods for a project of the plurality of projects;
calculating a resource load for tasks pertaining to each time period of the generated list of sequential time periods;
generating a graphic that visually indicates the resource load for tasks pertaining to each time period and a priority of each task of the number of tasks for each time period;
providing the graphic to a user via a graphical user interface; and
continuously modifying a priority of any task of the number of tasks based on a project buffer consumption percentage of a longest chain to which the task belongs and based on a chain completion percentage of the longest chain to which the task belongs, wherein the priority of the task is calculated across the plurality of projects so as to accommodate the critical chain.

21. The method of claim **20**, wherein the first step of generating a list comprises:

generating a list of sequential time periods for the project, wherein each time period comprises any one of: a day, a week, a month, and a year.

22. The method of claim **20**, wherein the step of calculating a resource load comprises:

calculating a resource load for tasks pertaining to each time period and reading at least one of the following for each task:
a priority of the task;
a division of the task;
a portfolio of the task;
a business unit of the task;
a project of the task;
a customer of the task;
a project manager of the task;
a task manager of the task; and
a status of the task.

23. The method of claim **22**, wherein the step of generating comprises:

generating a graphic that visually indicates the resource load for tasks pertaining to each time period and at least one of the following for each task for each time period:
a priority;
a division;
a portfolio;
a business unit;
a project;
a customer;
a project manager;
a task manager; and
a status.

24. The method of claim **23**, wherein the step of generating further comprises:

generating a bar graph including a bar for each time period, wherein each bar visually indicates the resource load for

tasks pertaining to each time period and at least one of the following for each task for each time period:
a priority;
a division;
a portfolio;
a business unit;
a project;
a customer;
a project manager;
a task manager; and
a status.

* * * * *