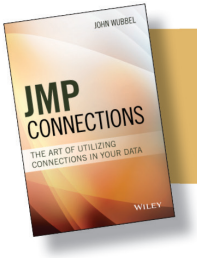
JOHN WUBBEL

JMP CONNECTIONS

THE ART OF UTILIZING CONNECTIONS IN YOUR DATA

WILEY



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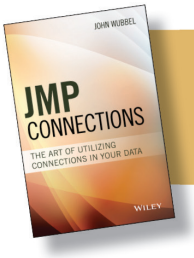

CHAPTER 1

Generalized Context for Decision Process Improvement

1.1 *Situational Assessment (current state)*

1.2 *Problem Statement*

1.3 *Visualizing State Transition*

1.4 *Metrics On-Demand*

DECISION PROCESS IMPROVEMENT FOR CORPORATE PERFORMANCE MANAGEMENT

Business is making clear that to stay competitive in the market we need to make decisions quickly and often with disparate data sets. JMP CONNECTIONS should be viewed as a business-oriented data discovery tool and is not an information technology (IT) or enterprise SAP®[1] Centric model because as is so often the case, data sets are not under the control of the IT department. Data may reside in silos, dozens of spreadsheets, or proprietary database applications. Thus, we can best describe this exercise as the "decision process improvement." If we can improve on the way metrics are produced, it can directly improve the timely implementation of actual decisions for corporate performance management.

The Holy Grail of the Information Age particularly in the information technology (IT) shop is the notion of data integration and interoperability. The Institute of Electrical and Electronics Engineers defines *interoperability* as:

> The ability of two or more systems or components to exchange information and to use the information that has been exchanged.

Unfortunately, interoperability has never been entirely achieved across a large enterprise before.

However, in support of staying competitive, the popular business press and IT periodicals have been pushing "business intelligence" (BI). Business intelligence is a broad category of applications and technologies for gathering, storing, analyzing, and providing access to data to help enterprise users make better business decisions.

[1] SAP stands for Systeme, Andwendungen, Produkte in der Datenverarbeitung, which, translated to English, means Systems, Applications, Products in data processing.

As postulated in the Preface, a tough economy implies a propensity to cut back on expenditures across a wide cross section of the enterprise that may also include BI software acquisitions. Utilizing JMP Pro®, the following pages will show precisely how the development of state-of-the-art metrics can be facilitated without the need for a major capital expenditure (CAPEX) project.

1.1 SITUATIONAL ASSESSMENT (CURRENT STATE)

ADVANCEMENT IN METRICS FOR BUSINESS AUGMENTATION

Before describing the common state of affairs that may be typical from small to large businesses, a framework for visualizing capability maturity with regard to the development of metrics and their use is outlined in Figure 1.1.

0. The lowest level of capability maturity (Level 0) would be a business or organization that may not have an IT department. Most of the management and reporting of business data is done using spreadsheets and perhaps the facilities of software office suites/applications for presentations. Reporting may be ad hoc or sporadic due to such factors as data that is not readily in a form for use in conducting statistical analysis when required. Companies often have so much data that they realize knowledge is locked up; however, they have no practical, inexpensive way to develop and utilize it.
1. The first level of maturity (Level 1) is where companies produce dashboards, scorecards, and KPIs on a regular basis. Perhaps on an annual basis, metrics are reviewed for relevance as needs change over time. Metrics retained may be refined and presentation and timely delivery mechanisms are *level set*[2] depending on who is to be receiving them and at what levels of the enterprise they are to be receiving and using them. Publishing BI tools like dashboards (DBs) and scorecards (SCs) have measurable cycle times.

[2] A situation in which everyone in a group has a basic understanding of a situation.

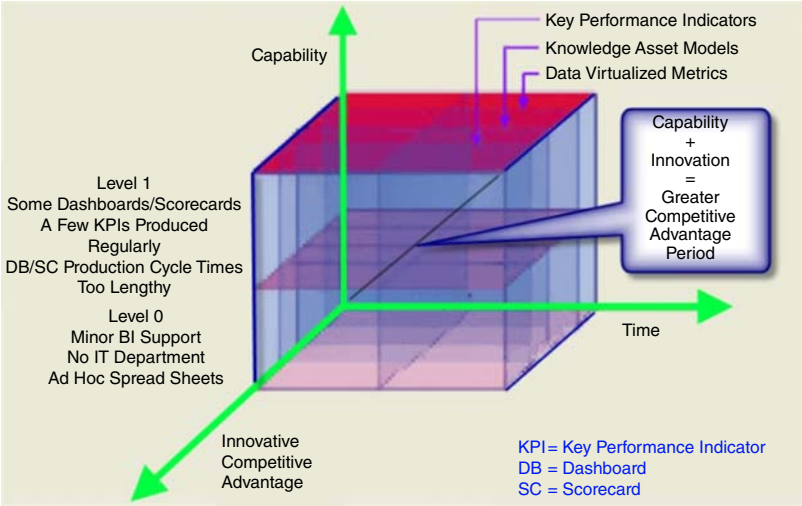

Figure 1.1 JMP CONNECTIONS Capability Maturity Model Levels 0 and 1

2. The second level of maturity (Level 2) for an organization would be a realization that some subset of deliverable metrics could be converted to metrics "on-demand." In identifying these on-demand metrics, the cycle time to generate or refresh a set of deliverable dashboards would be completely eliminated. (See Figure 1.2.)
3. The third and highest level of maturity (Level 3) is a two-part configuration. (See Figure 1.2.)

Level 3, Part 1

- Eliminate cycle time to create on-demand metrics resulting in reduction in FTEs.

Level 3, Part 2

- Human capital resource reallocation for:
  - Performing advanced statistical analysis
  - Predictive analytics and modeling

Level 3, Part 1, maturity level, focuses on reducing the time it takes (cycle time) to produce the metrics on a scheduled basis,

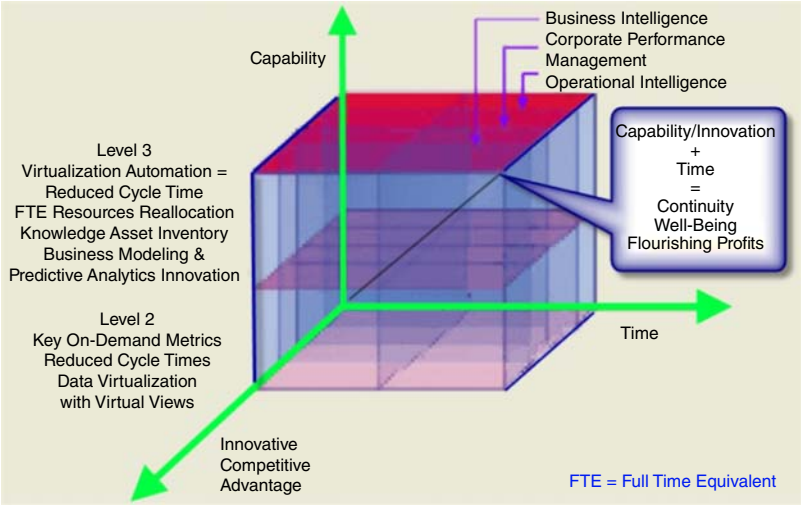

Figure 1.2 JMP CONNECTIONS Capability Maturity Model Levels 2 and 3

thus in turn reducing the number of FTEs required to produce those metrics. One FTE required to update a dashboard every week does not leave enough time for any other production tasks for metrics. The amount of time for an FTE is finite. As hours are freed up, other knowledge within the data sets can be developed and utilized. Achieving the second level of maturity leads into Level 3, Part 2 because now predictive analytics and the full power of JMP Pro can be leveraged perhaps without the addition of more FTEs. The graphic view in Figure 1.3 summarizes the reference model for maturity capability for business intelligence metrics.

The development of JMP CONNECTIONS is applicable to literally every type of business. All examples cited in this book are totally fictional and for illustrative purposes, which can be adapted to any business. The examples are generic in the sense that the common fuel crucial to business execution is the enterprise data, mature knowledge assets, and performance indicators across the spectrum of organizations that desire optimal results. In many circumstances, particularly in larger firms, one expects to find whatever data they need on the large enterprise database applications. In fact, the information is out there but its access is less than ideal. It may in no way be in a

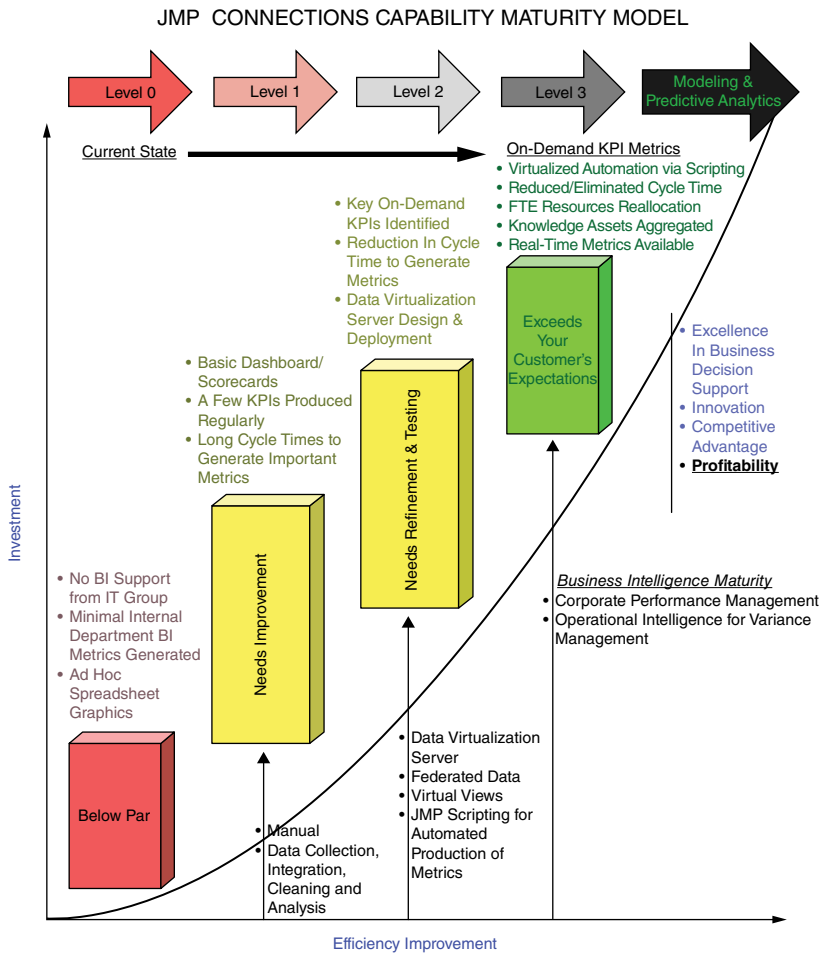

Figure 1.3 JMP CONNECTIONS Capability Maturity Reference Model

format to provide any statistical analysis capability. It lacks a certain agility for manipulative processes for generating BI tools or data. It is a "what you see is what you get" due to the hard-coded requirements built into the application. Consequently, a query returned is often a table of data or records that do not necessarily communicate or impart knowledge to the recipient. Something extra needs to be done.

Additionally, one would think that, especially within technology firms or scientific and engineering firms, data management would be state of the art. For many and perhaps for a majority, business is

conducted using spreadsheets, small desktop database applications, web applications, text files, and sticky notes. In fact, the proliferation of spreadsheets from one year to the next with no sense of version control is prevalent where many sheets act as placeholders for data rather than actually doing any computations or analysis.

Given the standard corporate desktop environment, when a set of metrics are required, they are likely prepared using a combination of the office suite applications. These may include the word processor, spreadsheet, and presentation software applications. A chart or graph may be present with some annotation explaining the meaning of the numbers and is the bare minimum or Level 0 of maturity for making metrics. Thus, it is useful to point out here exactly what types of BI solutions exist.

1. Executive scorecards and dashboards
2. Online Analytical Processing (OLAP) analysis
3. Ad hoc reporting
4. Operational reporting
5. Forecasting
6. Data mining
7. Customer intelligence

Each of the BI solutions has a data analysis ingredient or function that derives the reported out metric for a particular BI solution. While features and functions may be alike, what sets these apart is how they are applied to support decision making.

To be more precise in thinking about analytic metrics, there are three areas of data analysis derived from data science, information technology, and business applications that can be categorized as follows:

* PREDICTIVE (Forecasting)
* DESCRIPTIVE (Business Intelligence and Data Mining)
* PRESCRIPTIVE (Modeling, Optimization, and Simulation)

Without efficient sharing of operational business intelligence, a company is going to suffer breakdowns from small to large, be

unable to properly grow, and could even be flirting with massive disaster. A small issue, for example, can escalate into something very large very quickly if there's not good sharing of business intelligence. No operational intelligence, or incorrect intelligence, means that a company will create and execute strategies and plans (i.e., make decisions) that could inadvertently be bad for the company.

Beyond the Level 3 capability maturity, one may begin to get a sense about the concept of a BI Competency Center. A competency center is inclusive of all three areas when it comes to data analysis—PREDICTIVE, DESCRIPTIVE, and PRESCRIPTIVE—with respect to applying BI solutions to support various decision-making units within the enterprise. The competency center concept also can act as a facilitator for efficiently sharing operational business intelligence.

- PREDICTIVE

Even though the word *predict* is embedded in the notion of predictive analytics with inference toward trending and forecasting, the proper application of predictive analytics can also provide an essential competitive edge with regard to what is going to happen in the next minute, hour, or day. Consequently, our concepts of *on-demand and real-time metrics* are synonymous. An example of metrics on-demand is in Section 3.6, on page 80, Metric Case Study. A preview here of the case study illustrates how predictive analytics can be used by the maintenance department for real-time *business service management* (BSM). What is BSM? Simply, it means one department that provides services to another within a corporate enterprise. Business service management is an approach used in information technology departments to manage business aligned with IT services. In the case study, BSM is the relationship the maintenance department has with supporting manufacturing in a factory. On the shop floor of a factory, maintenance services are essential for operational efficiency. Alignment for one department makes sense when maintenance is interested in predicting machine part failures or determining the optimal time to do preventative maintenance that should be conducted for minimizing downtime in the factory.

DESCRIPTIVE

In a Focus Factory[3] manufacturing model, real-time metrics are essentially *operational business intelligence* where information is used on a daily basis to run production. Thus, the word *descriptive* implies it is the knowledge of the factory's contiguity (i.e., the "state of being"). To determine the cooperation of entities (e.g., persons) with equipment or to monitor the usage of equipment, whether good, bad, or steady state, for example, in a focus factory model, is to know the operational condition or situation for a given period of time.

Performance issues will be directly related to the type of metrics used to support specific areas of the factory. Measures will typically be at a more granular level. Current dashboard and scorecard metrics will reflect the higher level results and aggregate productivity measures.

PRESCRIPTIVE

The *prescriptive* kinds of metric examples are the types conducted prior to the introduction of a new process—the design of experiment statistical modeling to establish, for example, critical parameters and limits.

While having enumerated the types of BI above, none of these are inexpensive for companies finding themselves in uncertain economic situations. With commercial applications, no one size fits all and few at the retail level in the marketplace for commercial applications understand the level of data integration required. Data integration and its implementation is not generic or available off-the-shelf. Data integration enables interoperability across the enterprise, which is directly related to capability. In other words, the more integrated the data, the better the operability, which translates into a higher level of capability when utilized. With JMP CONNECTIONS, a lower granularity of data aggregation and subsequent integration is possible. (Granularity means a finely detailed but not necessarily more voluminous amount of data.) Granularity may be more desirable to go from a generalized metric to something more specific. Together, the data integration,

[3]The term *focused factory* was introduced in a 1974 *Harvard Business Review* article authored by Wickham Skinner [32].

data definition/description language (i.e., may use a declarative syntax to define fields and data types), and selection steps using the structured query language (i.e., using a collection of imperative verbs) for the codified business logic, collectively, should strive to produce only the minimal data set required to perform any analysis and the final metric presentation.

At the lowest level of maturity (Level 0), many key performance metrics are produced with a great deal of effort. Effort in effect means the non-automated tasks required from data gathering to finished presentations. From start to finish the cycle time for such efforts is associated with a (Level 0) maturity capability. The non-automated process of making a metric is the manual work done by hand and, when performed repeatedly, the business logic that goes into it is unconsciously executed by the analyst. The manual effort and repeatable business logic required is measured as cycle time in the generation of metrics. In order to reduce the cycle time, the manual work has to be off-loaded to the computer. To eliminate the manual work, the business logic is codified as Structured Query Language statements for retrieving data from the Data Virtualization Server (DVS) so that it can be acted upon by JMP. The business logic can also be written into JMP scripts for execution within JMP prerequisite for any analysis. If the metric is not a one of a kind or ad hoc production and is required periodically by management, the codification thereby reduces or eliminates the cycle time required to produce the metric by doing away with mundane manual tasks. More details regarding the technical aspects will follow in Chapter 2—Real-Time Metrics Business Case.

Even with the best visual presentations, graphical layout and designs offered by the office suites appear acceptable, but they are less than optimal compared to JMP visualization metrics. Third-party BI applications may require extensive programming to achieve even a partial analytic capacity. Unlike with JMP, the current state of an organization at a maturity Level 0 with basic office suites is challenged to perform any statistical analysis. A good place to start for an organization to understand where they are in terms of where they are on the capability reference model is to write a clear and concise problem statement that can guide them forward from (Level 0) through (Level 3) on their Decision Improvement Process journey.

1.2 PROBLEM STATEMENT

COMPETENCY CENTER METRICS ON-DEMAND

A problem statement is a description of the issue at hand. It includes a vision, issue statement, and a method to solve the problem. The problem statement below expresses in words the effort and focus it will take to achieve the task and represents a solve-able problem.

The primary problem is to be able to journey from a (Level 0) maturity level to the (Level 2) capability. The transition from the current state to the "metrics on-demand" basis is a realization of the following:

1. More realistic view of current state/transitions in support of corporate strategic goals
2. Savings realized via reduced FTE hours for developing metrics
3. Potential redeployed human resources
4. More precise and reliable metrics
5. Higher quality of decision making possible
6. Better utilization of additional knowledge
7. Realizing an inventory of "knowledge capital" from the knowledge assets developed
8. Innovation in delivery methods and timeliness

As with most problems, certain assumptions go with the territory. These include the following:

1. A department or organization is already generating periodic business intelligence.
2. The current metrics do not or cannot answer extemporaneous questions.
3. The customer or end user has a sense of latency about the timely receipt of the metrics.
4. There is no business intelligence competency center across the enterprise for establishing standards.
5. The metrics may or may not support corporate initiatives.
6. Data integrity may be less than perfect.

While on the journey transitioning through each maturity level, the organization at some point should establish a Business Intelligence Competency Center (BICC). There are several factors that make this idea lucrative. The mind map in Figure 1.4 is representative in the context of bringing metrics through the levels of maturity that is simply not employing just any person(s) or group(s) of people, rather a center of excellence dedicated to the development and production of business intelligence metrics as part of the value-added piece to this innovative work.

Large businesses typically have multiple departments. Many of the departments are creating metrics and there is often duplication of work. Knowing where these duplicate work efforts exist is a target for becoming lean (improve efficiency and productivity and reduce waste), resulting in substantial savings. When there are several groups producing similar metrics, there can be ambiguity with respect to the meaning of the resulting data. The BI competency center should be the "go-to" group for enterprise organizations to get their key performance metrics. There are solid reasons for taking this approach. The competency center can establish standards and guidelines for producing metrics with consistency. In other words the inputs and outputs can be validated. Given that so many companies are dealing with legacy applications, database servers, and assorted data silos, the competency center can resolve data ambiguity between systems. Developing and maintaining an ontology could be appropriate in some cases. In other words, a glossary or vocabulary defining the terms that are common for metrics and unique for a particular business facilitates better communication between people when discussing or analyzing metrics.

At the Level 1 maturity, working up the metrics entails the aggregation of data. In other words, a certain amount of cycle time is used up in gathering that data from different silos, repositories, and exportable resources. Prior to doing any statistical analysis may require data integration work. It is very common that to compute a KPI, data comes from two different resources and must be combined. Much of that work might be using some information from a spreadsheet, information from an SAP application resource exported to a spreadsheet, and a cross reference to another database table. The integration effort might include writing some spreadsheet macros and using lookup

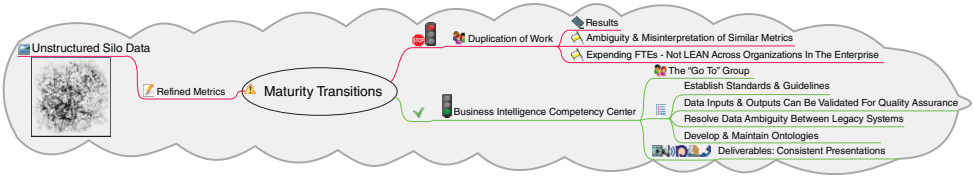

Figure 1.4 Maturity through Level State Transitions

functions simply to get to a point where a chart can be generated. Many customized requests for metrics are not available from the large enterprise applications because the data used in operations may only be local and owned by the department.

The person doing the metrics is familiar with and is perhaps the subject matter expert (SME) of raw data. His or her feel or sense about the data, where it comes from and how it is entered, is more acute and is evident when it comes to such things as questionable data, values, or the semantic context from which it is derived in the business. Because of this awareness, along with integration, data may need to be cleaned by a summary review. Does a certain record or data item make sense? When something does not look right or an outlier is seen that is normally not the case, the cycle time to create the metric is expanded due to the fact that one has to investigate the validity of a single data point. The data might have been incorrectly entered, missed, or is of the wrong type or format. Data integrity issues are typical when multiple people are entering data into spreadsheets where entries cannot be validated. These are known as errors, are very subtle, and are missed "right first time" opportunities.

To understand the problem statement, outside of living at the Level 1 maturity space, describing the environment aids us in defining a better way toward achieving the next level of capability. A simple but not uncommon development cycle, Figure 1.5 depicts a current Level 1 maturity state.

The entire cycle time to completely update a set of dashboard slides for presentation from start to finish on a weekly basis is a limitation. It is a limitation due to the fact that a person has at most 40 hours per week, leaving no time to accomplish other tasks or improve on the ways he or she works. No new metrics can be researched, designed, and deployed under these circumstances. A good example of time consumed would be the manual effort to include the query of a third-party database application, using an export template to extract that data into a spreadsheet, followed by any statistical analysis required that needs to be conducted in JMP in order to complete the dashboard development cycle.

In summary, recognition of the problem is a statement elucidating the current state in contrast to a usable set of metrics that are literally

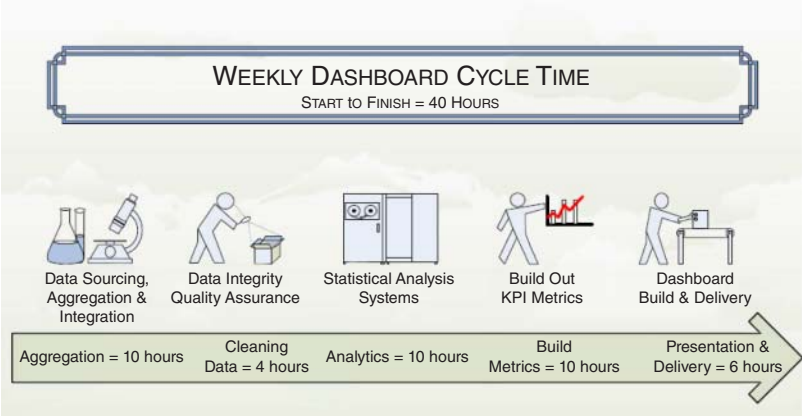

Figure 1.5 Common Cycle Time to Build and Publish a Weekly Dashboard

available at our fingertips at any time. Reaching the pinnacle of real-time metrics is a series of steps or transition processes that comes by solving these problems and turning them into the equity of competence, a combination of knowledge, skills, and behavior used to improve performance.

1.3 VISUALIZING STATE TRANSITION

REACTIVE DECISION MAKING, PROACTIVE DECISIONS

In the previous section, the generalization of moving among the various maturity capability levels is a process of steps within a level as well as between levels. To abstract the actions of transiting from one to the other, one way to visualize states and the transitions is through a state table. A state table is essentially a truth table in which some of the inputs are the current state, and the outputs include the next state. To make this concept less abstract, theoretical computer science makes use of state transition tables in automata theory[4] and sequential logic. There are a number of tables, one-dimensional and

[4]We leave it to the reader to explore advanced readings in automata theory, mathematical models, and problem solving.

two-dimensional, and from these state diagrams can be sketched. However, in this section, visualizing the transitions and resulting transformations, the discussion will be more about the tangibles the analyst has to deal with and not about the theory. The theory of state transition gives us a general context or model to think about or to intellectualize the mechanics. The tangible factors are the tools, resources, and manual tasks that could be called the practical state the analyst finds at the beginning and throughout the journey in building the JMP CONNECTIONS platform.

Assuming metrics "on-demand" is a more desirable state based on the notion that the immediacy is more relevant particularly in terms of decreasing reactive decision making, certain things must happen in transition. First, a metric must have some measure of repeatability and thereby lend itself to some degree of automation for reproduction purposes. If the computer can replicate the manual labor involved in producing the end product of user accepted KPIs, then we can see our way through toward reducing the hours for an FTE to do the same, in other words shrinkage of the cycle time to produce each metric.

Data aggregation is another time-consuming component within the cycle time. There are a number of ways to render aggregation out of the cycle time equation. First and foremost, JMP provisions a wide variety of connectivity methods that can be optimized for tapping data resources. These include the following:

1. A default feature, access to JMP tables
2. Electronic serial data connectivity to instrumentation
3. Microsoft Excel® spreadsheet importation
4. JMP Excel Add-In and Profiler
5. Database connectivity via ODBC drivers and SQL interface
6. Uniform Resource Locator (URL) via http protocol through JMP
7. Connectivity to SAS and SAS databases

JMP CONNECTIONS may be analogous to open pit quarry mining [22] because mineral wealth may be exposed at the multiple layers of geological formations. Data mining can expose a wealth of knowledge and opportunity with connectivity options.

The oldest form of connectivity in the data processing world and supported by JMP is using a serial/null modem cable or modem with communications software to connect to a device whereby the device is sending or streaming data that may be useful in monitoring a piece of equipment. JMP documentation and sample code are available for this type of connectivity.

Spreadsheets can be imported as well; however, sometimes there are issues with the data in regards to type, format, and qualitative interpretation. JMP Add-In functions facilitate a two-way data pathway between JMP and spreadsheet data. Spreadsheets can be representative of the data as though it were located in a database table. The only limitation is the fact that it cannot be queried like a database using Structured Query Language. It is a straight open-file operation that brings the sheet into a JMP table.

Database connectivity is the most flexible in terms of access to most commercial and open source database servers due to the fact that ODBC drivers are available for different data source types, connection information, and credentials for access. It is also the most powerful in allowing the BI developer to query only for an exact data set across more than one table.

The URL connection also provisions a whole new bevy of options for garnering data for use in JMP. Public domain data sets available on the World Wide Web or on intranet systems opens up a whole new resource. While JMP does not give you access to real-time streaming data, say for example from an automated manufacturing machine, there may be other innovative ways to retain the data. The JMP Pro Version 11 Scripting Guide, Chapter 14, Extending JMP, states that real-time data capture from a device is possible through the serial port. In the semiconductor industry, electronic test equipment such as a logic analyzer will be capable of dumping data to the serial port. A JMP datafeed object will enable a connection to the data, capture the data, and utilize the data with background event processing.

For example, manufacturing execution systems (MESs) today are generally automated, and consequently terabytes of data can come streaming from production floor equipment while in operation such as from (PLC) controllers, sensors, and temperature and humidity probes to name a few.

Many manufacturing firms use historian systems for management of real-time data and events coming from production equipment. With a historian system implemented in a large manufacturing production floor environment, data may stream so fast that it is more practical to catch and compress the data for storage typically in a proprietary format as opposed to storage into a relational database. The data may later be stored in a database for analysis and accessed via JMP. One type of application here would be to monitor equipment for reliability and dynamically create control charts to monitor performance for overall equipment effectiveness (OEE).

With these connectivity options, a certain amount of creativity can go a long way. The multitudinous connections with JMP as the centerpoint of all these potential component parts works in favor of aggregation.

In practice, and as a matter of practicality, departments often find themselves awash in a sea of spreadsheets. The practicality is to reduce the number of spreadsheets. But how can you reduce the number of spreadsheets when people need the data they contain? Even though JMP can access data in spreadsheets, there still exists a gap with regard to optimal aggregation when data is stored in disparate places. This fact hinders the ability to completely arrive at a Level 2 capability. Hindrances include difficulties in coding or scripting logic that yields the automation for lowering FTE hours required through the cycle time reduction for producing the metric. Without a complete aggregation, data integration is not possible for data sets that remain in their mini-silos and are lost opportunities with respect to graduating this data from an unstructured state to structured data where the integration opens new data discovery opportunities. Another way to think about this situation is when the data remains in silos, one can only have a single-dimensional view. Once the data is aggregated, multidimensional views become available. Disconnected data is simply inefficient.

To effectively overcome this roadblock to attaining a balanced and near-total aggregation of data from your inventory of spreadsheets is really quite simple. The solution will be discussed with details in Chapter 2.

The final concept to transition from a Level 1 to a Level 2 capability are the data discovery opportunities that come out of the data

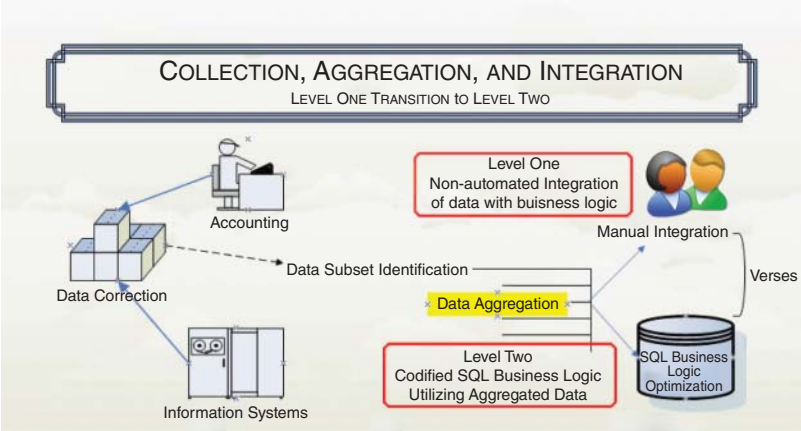

Figure 1.6 Transition from Level 1 to Level 2

integration step. To refresh, during the Level 1 cycle time there are many instances where the integration of collected data is also a manual task to get to a graphic or KPI. (See Figure 1.6.)

In the JMP CONNECTION scenario, it is very easy to prototype the abstraction of integration, for example, via structured query language statements from a database connection where SQL JOIN commands can pull from multiple tables. In fact, a useful database feature is creating a VIEW which is a virtual table. One does not have to recreate these week after week. The database server maintains a VIEW so they can be brought into JMP via the ODBC execution of SQL or running a JMP script that opens the database connection, reads in the table, processes the statistical analytics, and generates final output in one stroke.

Data integration at this point may take only as much time as you are currently spending on a metric within your Level 1 cycle time. However, once aggregation is defined and becomes available, more time developing data integration may result as new insights become apparent. This outcome is a direct benefit of automating to a real-time metric delivery system.

Visualizing the progress, state transitions, and the transformation across the levels of maturity capability, both in theory and in practice, keeps development on the right path and on track. The current state, new inputs, actions followed by outputs, and acceptance from old state

to a new state is a way to think about the quality of your work and avoid any superfluous metrics as well as non-value-added work on the project. The simple analogy of a closed or finite state machine is that of a door. If you build a door, the initial state is open. The transition happens when it closes and its final state is a door that is closed. When someone takes the action to enter through the door, it transitions to the open state. If the builder did not get the door jam square upon hanging the door, and closing it the door jams, then somewhere in the construction either some work was not done or in this case some non-value-added work was done incorrectly. As long as we are concerned about efficiency, higher productivity, and better decisions through metrics, we might as well maintain a realistic vision about our JMP CONNECTIONS work in order to obtain the goal of business intelligence competency.

1.4 METRICS ON-DEMAND

EXCEED CUSTOMER EXPECTATIONS = BEST-IN-CLASS METRICS

The Best-in-class Metrics is a Business Intelligence Competency Center with the implication that the best metrics produced is the objective to satisfy the mission to exceed customer expectations. The rate of change at which we approach best-in-class status is a function of the ability to reduce the production cycle time of metrics and in turn FTEs. The mind map in Figure 1.7 is a point of reference for the next discussion about factors involved to exceed customer expectations.

The transition to metrics on-demand may be incremental as an organization moves to the Level 2 capability. Recall, the purpose of developing through the Level 2 virtualized deployment of data is not to supplant other major enterprise systems; rather it is preferable to be operating on local data that is not under the control of the IT department. Granted, this platform model might be pulling subsets of data from various enterprise resources, but people within the organization or various departments will be using the resultant metrics in their own unique ways to support their mission.

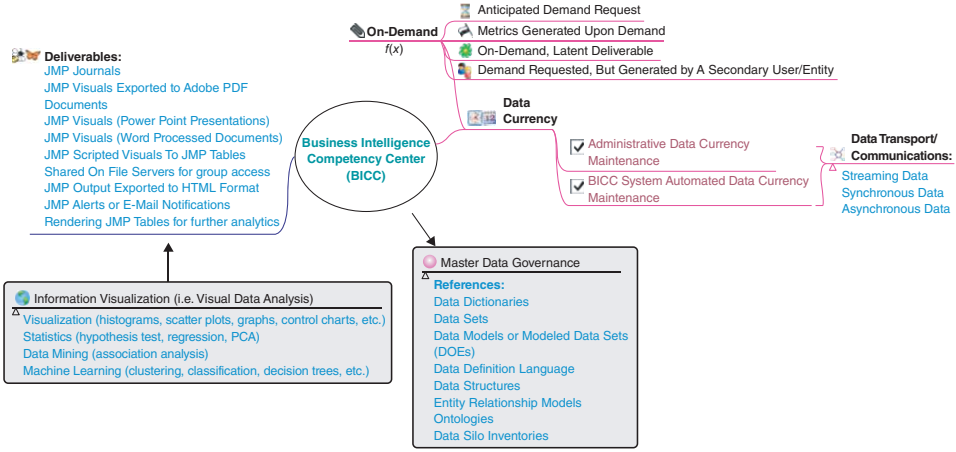

Figure 1.7 Achieving On-Demand Capability

Achieving on-demand capability requires three attentive considerations. First and most obvious is that raw data must be maintained and up to date or kept as current as possible. This task is most demanding when harvesting from various silos of data. For example, when JMP has no access to an external database application, alternatively one is required to export data sets. Additional steps might be involved to aggregate the data from the silo into the local database repository. In Section 2.1, the aggregation of data from many silos into a local database as a small warehouse will be discussed.

A secondary consideration involves the planning on how the metrics are going to be delivered once JMP is able to provide finished output. With JMP CONNECTIONS, there are many options available as follows:

1. JMP journals.
2. JMP add-in for rolling visuals into Adobe® PDF or Microsoft PowerPoint® presentations.
3. Save JMP scripts to JMP tables for later reruns.
4. Incorporate into JMP scripts embedding graphics into word processor files.
5. Saving to Adobe Flash SWF files.
6. Locating JMP output to shared file servers for group access.
7. Incorporating into JSL, JMP output can go directly to a web server for online delivery for web browsing.

In most cases, end-user customers will probably dictate how and where they want to see the metrics, and so a combination of options will likely be put into practice. How the presentation is deployed can be easier if one can anticipate the end-user requirements.

Finally, the metric currency of data with regard to its suitable timeliness is a question that will be asked. Metrics on-demand implies that when a customer asks for it, either the metric has to have already been generated with the latest data available or the metric is generated immediately upon the demand request with minimal latency to delivery. Does the system automatically maintain currency or are there times where either an administrator or end user invokes regeneration for a metric? The answer to this question really depends

on the data. There are three factors that may drive how data currency is resolved as follows:

1. Streaming data
2. Periodic or synchronous data
3. Ad hoc (aka, asynchronous) data

Data that may be arriving as a stream may require a constant refresh, for example, monitoring the performance of a machine. Periodic data may arrive at specific intervals to the system, therefore generating the metric, and remaining current may only occur on a periodic basis as well. Ad hoc data comes into the system at unpredictable times. In order to maintain a current metric one might have to rely on the system to detect the event and run a batch or cron (i.e., scheduled) job in the background to update output for the customer. A cron job is simply a time-based job or task scheduler that uses a table or crontab containing the command for each job to run at a specific time. Each of these scenarios is a technical decision that factors into the presentation delivery design, implementation, and deployment task.

Presentation formats and means of delivery should be as automated as possible since the actual presentation is recognized as a component of cycle time at the Level 1 capability. In order to eliminate cycle time, which is the key factor in achieving Level 2 capability, if the computer system upon which this model is implemented can perform these tasks and it becomes a feature of the JMP CONNECTIONS system, the savings is a huge benefit for everyone. And just like the data aggregation and integration, once put in place one does not have to come back week after week to perform some manual task prior to producing the desired KPIs.

As the Level 2 capability incrementally comes online, less time can be devoted to cyclic output for metrics and more time spent developing new knowledge from the data now under your control. For example, what may materialize is the ability to validate data and run exception reports to identify anomalies. Catching issues or defects in methods or processes early can equate to a higher level of quality assurance and great savings.