Evaluating Data Warehousing Methodologies: An Evaluation Process

by Dr. James Thomann and David L. Wells

Introduction

The first article in this series described a set of criteria for evaluation of data warehousing methodologies. Figure 1 briefly summarizes those general criteria that apply to the industry as a whole. General criteria are academically interesting, and they are adequate to support research activities. To be applied to specific organizational needs, however, they may need to be customized for the needs and culture of that organization. Even when customized, criteria alone are not sufficient to select a method and put it into practice. A process to systematically apply the criteria is also necessary.

The first article also examined similarities of business processes with methodology, and stated that “methodologies are, in fact, the business processes of IT.” More precisely, we believe that methodologies are the foundation upon which IT business processes are based. Implementing a business process for data warehousing is demanding. It requires systematic evaluation of methodologies, careful selection of a single method, and managed implementation of that method as a business process in practice. These phases together provide the path from many choices of method to a successful warehousing business process. Although the focus of this article is the evaluation phase, an overview of the entire sequence helps to understand evaluation in context. Figure 2 illustrates the three phases and the flow of results among them.

Evaluation is performed as a set of steps that produce the essential inputs to the selection phase. Evaluation steps include review of methodologies, review of criteria, and short-listing of methodologies. The significant results of evaluation are a short list of methods and a set of selection criteria. The steps and results are discussed in greater detail throughout the article.

Selection rigorously assesses the set of short-listed methodologies against the selection criteria to decide upon a single method to be put into practice. Selection generally demands some opportunity to perform the activities, and to build and use the deliverables of each method.

Practice describes both a phase and an end state. Practice is the phase in which a method is implemented and adapted to the needs of an organization. Practice is also the desired state in which the selected method is practiced as a business process, and is continuously evolved with changing business and technical needs.

Together these phases provide a process to systematically select a data warehousing method with the highest probability of sustainable success throughout the life of the warehousing program, to implement that method as a business process, and to manage the process for desired business results. The process is
designed to achieve three outcomes. First, the methodology must be successfully implemented. Second, it must be understood and used by the people who are participants in the data warehousing program. And finally, it must be effective to achieve business results using data warehousing technologies.

The remainder of this article details the evaluation phase. Selection and practice are topics of a future article.

<table>
<thead>
<tr>
<th>criterion</th>
<th>description</th>
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<tbody>
<tr>
<td>results oriented</td>
<td>has a well-defined set of deliverables and a distinct product</td>
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<tr>
<td>fully described components</td>
<td>each component is fully described and has a defined role</td>
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<tr>
<td>cohesion of results</td>
<td>Every result produced throughout the process has a reason to exist</td>
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<tr>
<td>rigor in the process</td>
<td>is detailed enough to ensure no gaps in flow of results and activities</td>
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<tr>
<td>appropriate level of detail</td>
<td>sufficiently detailed to achieve desired rigor, but not excessively detailed</td>
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<tr>
<td>familiarity of techniques</td>
<td>uses familiar, common, and proven techniques to produce results</td>
</tr>
<tr>
<td>process flexibility</td>
<td>adaptable to unique needs of organizations, projects, and teams</td>
</tr>
<tr>
<td>project planning usefulness</td>
<td>is useful as a planning template for projects</td>
</tr>
<tr>
<td>role/responsibility identification</td>
<td>identifies roles and responsibilities to perform activities &amp; produce results</td>
</tr>
<tr>
<td><strong>process usability criteria</strong></td>
<td></td>
</tr>
<tr>
<td>adaptable</td>
<td>quickly and readily adjusts to unanticipated project circumstances</td>
</tr>
<tr>
<td>model based</td>
<td>supports and employs modeling at multiple levels of abstraction</td>
</tr>
<tr>
<td>goal driven</td>
<td>facilitates results-based definition and measurement of project goals</td>
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<tr>
<td>traceable</td>
<td>results are fully traceable through a network of deliverable dependencies</td>
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<tr>
<td>teachable</td>
<td>can readily be learned by anyone with the requisite skills, &amp; experience</td>
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<tr>
<td>documented</td>
<td>each component (activities, deliverables, etc.) is documented</td>
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<tr>
<td>team enabling</td>
<td>process &amp; deliverable dependencies help to identify team dependencies</td>
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<tr>
<td>referenceable</td>
<td>has a community of users who can attest to its usability</td>
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<tr>
<td>measurable</td>
<td>provides ability to track process and project metrics</td>
</tr>
<tr>
<td><strong>data warehouse enabling criteria</strong></td>
<td></td>
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<tr>
<td>scaleable</td>
<td>not size and scope dependent; works for warehouse, mart, and ODS</td>
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<tr>
<td>comprehensive</td>
<td>includes a robust set of results for all parts of the warehousing product</td>
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<tr>
<td>evolutionary</td>
<td>uses concept of multiple, small projects to accomplish large objectives</td>
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<tr>
<td>business information focused</td>
<td>business information needs are significant as both inputs and results</td>
</tr>
<tr>
<td>data structure independent</td>
<td>without data structure bias; works for both relational &amp; dimensional data</td>
</tr>
<tr>
<td>acquisition method independent</td>
<td>without acquisition technique bias; works for both “push” and “pull”</td>
</tr>
<tr>
<td>vendor &amp; tool independent</td>
<td>not specifically dependent on a single vendor’s tool set</td>
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**Figure 1 – Summary of Evaluation Criteria**
Evaluation Phase Overview

The purpose of the evaluation phase is to produce as deliverables those things that are needed as input to the selection phase. Evaluation produces two primary deliverables – a set of selection criteria, and a methodology short list. Evaluation is performed in three steps as illustrated by Figure 3 and described below:

- **Criteria review** identifies those criteria that are most important to ensure success with a methodology in the environment and culture where it will be implemented and practiced. The objectives are to identify the critical success factors of the organization, to know the characteristics that any acceptable methodology must have, and to refine the criteria to align with those factors.

- **Methodology review** is essential to translate methodology data into methodology knowledge – the collection of data about a methodology that may be useful to evaluate and select among methods. Methodology review includes comparative ratings of methods using a standard set of criteria.

- **Short list development** produces a list of two to five methodologies that are forwarded to the selection phase, along with supporting profiles of the short-listed methods. This is an iterative process of affirming the strong candidates, and culling (filtering out) the weak candidates based upon the methodology ratings against the refined criteria.

As you read the detailed descriptions of evaluation steps that follow, it important to remember that these steps are not sequential. Steps may be performed in parallel. Methodology review may begin before criteria review is completed, as it requires only one of the two outputs that are produced by criteria review. The steps may also be performed iteratively. Methodology review, for example, may discover a need to better define or further refine the evaluation criteria, refocusing attention on criteria review. Similarly, short list development may expose a need to extend methodology knowledge, returning focus to the methodology review step.

Methodology evaluation is a team activity performed primarily by the people who will practice the chosen method. We recommend a small team of five to seven people, composed of a warehousing program or
project manager, one person with organizational standards and/or process responsibility, and several practitioners representing a broad range of data warehousing skills.

Review of Criteria

Criteria review identifies the set of criteria that are most important to ensure success with a methodology in the specific organization, environment, and culture where it will be implemented and practiced.

Every organization is unique, with different needs, people, practices, processes, standards, and past experiences with methodology. Unrefined evaluation criteria provide a key input to the evaluation process, but they do not represent the unique needs of a particular organization. Within a single organization, all criteria are not equally important to success. Those that are of greatest importance must be identified. All of the criteria may not be appropriate in some organizations. Some may need to be adjusted or entirely removed from the list. And the general set of criteria may not be all that an organization needs to use. New criteria may be added to the list.

Criteria review identifies the characteristics that any acceptable methodology must have, and establishes the critical success factors for methodology value and effectiveness in the organization. The review delivers two significant results that represent criteria customized to specific organizational needs:

- **Refined Evaluation Criteria** is the set of evaluation criteria that is used to evaluate and compare methodologies, and that is the basis from which selection criteria are developed. These criteria may be a subset of the unrefined evaluation criteria, may be adjustments and adaptations of those criteria, and may include new criteria unique to the needs and culture of the organization. Each criterion on the list needs to be fully described including a name, a description of what the criterion is, and examples or indicators of how the criterion is realized in a methodology.

- **Selection Criteria** is the set of criteria against which short-listed methodologies will be rigorously tested to decide upon a single method to implement. This deliverable is a subset of the refined evaluation criteria, ranked and sequenced by relative importance of each criterion to successful practice of the method. Expect a list of at least fifteen to twenty criteria, with the top ten distinctly ranked and ordered, and with the top three to five identified as critical success factors. Each criterion is supported with the following items: name, description, examples or indicators, priority ranking, reason for the ranking, and an indicator if the criterion is a critical success factor.

Note the distinction between evaluation criteria and selection criteria. Selection criteria are explicitly not used by the methodology review step, because review of methods should be performed without bias of the selection process. Evaluation criteria exist to achieve a consistent collection of knowledge for each of several methodologies – to be able to compare them. Selection criteria exist to help choose among multiple methods – to assess their ability to meet defined needs.

Criteria review requires two inputs to produce the results described above. A set of unrefined criteria to be refined is essential to get started. We refer to these as the general criteria. They described in detail in our first article and summarized in figure 1. It is intended that these criteria be refined to specific organization needs, and applied for methodology evaluation and comparison.

The second essential input is organization data – information about the environment and culture of the organization that will practice the methodology. Some of the important factors include:

- organization size and structure,
- past experience with formal methods,
- current methods in practice,
- adaptability to and capacity for change,
- experience with data warehousing, and
- the current state of the data warehousing program.
Anything you can know about the organization that helps to tailor the criteria is useful organization data. Data that indicates organization strengths can guide you to specification of criteria that help to leverage those strengths. Data indicating weaknesses and risk areas guide specification of criteria for risk mitigation.

Given the essential inputs, the step consists of a set of activities to produce the desired results. Each step contributes to producing refined evaluation criteria, selection criteria, or both. While the activities are described sequentially, they are likely to be practiced in an iterative and non-sequential fashion. Criteria review activities include:

- **Understand and Adapt the General Criteria**

  The objectives of this activity are to ensure that each criterion has consistency of meaning to all participants, and to place each criterion into organizational context. Read each criterion and its description. Seek examples from any currently practiced methodology or business process to illustrate the criterion. Once understood, examine the name and description for appropriateness to your environment. Consider environmental factors related to process, project, and quality management.

  Each criterion might be renamed, or its description reworded, to better express its meaning in your particular environment. Adaptation for more specific descriptions and adjustments for more familiar language are both appropriate. The general criterion *familiarity of techniques*, for example, describes the method as “uses familiar, common, and proven techniques to produce results.” You might extend to include a more specific description, such as “uses the IDEF standard to represent logical data measurable criterion – “provides ability to track process and project metrics” – might also be extended to describe metrics specifically desired in your environment.

- **Identify, Name, and Describe New Criteria**

  This activity focuses on completeness of the list of criteria. The list of general criteria may not include all evaluation criteria that are important to your organization. It is possible, though not essential, to add criteria to the list. Again, project and quality management practices may call for particular criteria.

  Quality assurance standards, for example, might lead to criteria about methodology features to verify completeness and validate correctness of deliverables. Examine past history with structured methods, and think about including criteria that are based on the reasons for success or failure of past initiatives. Past failures based on “too many forms,” or “too much bureaucracy” may be a reason to add some limiting criteria. Also consider adding criteria that help to ensure easy integration of a new method into the current culture – compatibility with current tools, for example. Whenever criteria are added, give them unique, meaningful names and support them with descriptions and examples.

- **Remove Unneeded Criteria**

  This activity reduces the criteria list to a manageable size for evaluation and selection. Beginning with a list of twenty-five general criteria, and adding as needed for organization specifics may produce a lengthy list. To reduce the size of the list, first remove any criteria that aren’t understood or for which you can’t find a meaningful example. (It is essential that you’ve first made an honest and concerted effort to understand them.) Next, remove any criteria where it is unclear why they matter to the organization. Finally, remove those that are in conflict with new criteria that you added. If, for example, you added a criterion to evaluate compatibility with your current tools, then *tool independence* is no longer an appropriate criterion.

  The ideal set of criteria, both for evaluation and selection, is a list of fifteen to twenty criteria representing all three categories – process completeness, process usability, and data warehouse enabling (see figure 1). A list slighly larger or smaller than the ideal is not cause for concern. A significantly smaller list, or one that entirely eliminates one category of criteria, is a cause for concern and you should revisit the first two steps.

  The list produced upon successful completion of this activity is the **refined evaluation criteria**
• **Rank the Criteria**

Ranking establishes priority and assigns order to some of the criteria in the list. For selection purposes, unlike methodology review, not all criteria are equal. The more important criteria need to be recognized as such. Identify the top ten criteria in order of their importance to success with the methodology. Use any of several ranking techniques (perhaps multiple techniques to assure completeness) to achieve consensus on an ordered list where there is a single number one criterion, a single number two criterion, etc. Rank criteria until you have a “top ten” list, and consider all criteria beyond ten to be equally important. Reasons for ranking in the top ten are many and varied. Some examples of reasons include avoiding causes of past failures, repeating past successes, and improving the probability that practitioners will accept the methodology.

• **Identify critical success factors**

A critical success factor (CSF) is any criterion that, if totally unsatisfied, is certain to lead to failure of the methodology initiative. Critical success factors will be a subset of the top ten list of criteria. Examine each of the top ten, asking “What happens if this criterion is not met? Is that a show stopper?” Expect that three to five criteria will emerge as CSFs. Do not expect them to necessarily be contiguous in the list. Optionally, consider re-sequencing the top ten list so the critical success factors are placed continguously at the top of the list.

The list produced upon successful completion of this activity is the **selection criteria** deliverable.

**Review of Methodologies**

Methodology review develops a profile of each methodology, and provides the means to compare functions and features of multiple methods. This step translates methodology data into methodology knowledge. The knowledge is structured to support later comparative analysis activities.

Each methodology is unique. Different organization, terminology, deliverables, level of detail, and degree of formality combine to make comparison of methods a complex and difficult task. Methodology profiles bring structure and consistency to the collection of methodology data. Common content and structure of profiles reduce the complexity of comparative analysis. These profiles provide the basis to knowledgeably affirm (forward to selection) some methods and to cull (remove from consideration) other methods.

Methodology review produces a single significant deliverable – methodology knowledge. Methodology knowledge is the collection of data about a methodology that may be useful to determine which methods comprise the short list. Both knowledge to help cull a method from the list, and data to help affirm placement on the list are of value. The knowledge is structured as a set of methodology profiles, each of which includes the following elements.

• The name of the methodology.
• The methodology source – vendor, author, consulting organization, etc. Is it proprietary?
• A checklist of deliverables categories. Does it include analysis, design, and construction deliverables for each of:
  - source data?
  - extract components?
  - transform components?
  - load components?
  - warehouse and mart data stores?
  - access components?
  - metadata?
✓ data cleansing components?
✓ data archiving components?

- A brief abstract, including a short text description of the method and comments about any features, functions, strengths, or weaknesses that deserve special attention.
- Rating by each of the evaluation criteria, and reason for the rating.

It is useful to organize the collection of profiles with (1) an overview, (2) a summary of similarities and differences, (3) a comparison chart that illustrates completeness in each of the deliverables categories, and (4) a comparison chart that illustrates rating by evaluation criteria for all of the methods.

Methodology review uses three inputs to produce the profile deliverables described above. A list of methodology candidates is necessary to identify which methods are to be reviewed. This is a list of all methodologies that are under consideration, and that should be reviewed prior to selection. It is not necessarily a list of all available methods, as some may be culled prior to evaluation. The candidate list must indicate the name of the methodology and its source. The list may also indicate degree of formality and whether the method is proprietary. The second input to methodology review is methodology data. This data is any available information about the methodologies included in the candidate list. Minimum essential data is descriptions of the activities, deliverables, and sequences of each method. Other useful data includes vendor information, books and documentation, case studies, reviews by industry analysts and standards organizations, and reviews and references of practitioners. The third input to methodology review is the set of refined evaluation criteria previously described. These criteria are needed by the rating activities of the review.

The methodology review step is carried out by performing the following three activities:

- **Prepare for Review**

  Begin the review activities by establishing and communicating review procedures, specifically determining

  - Who is responsible to review which methods? If your team includes individuals who have training and/or experience with any warehousing methods, consider how that may affect their review.
  - Will the same methodology be reviewed by more than one person? If practical within time and resource constraints, we recommend multiple reviewers. But this doesn’t mean that everyone must review all methods.
  - How will results of individual reviews be consolidated? When a method is reviewed by more than one person, a procedure to arrive at a single set of conclusions is needed.
  - What is the review schedule? Placing review activities in a limited time box helps to accelerate results.

  Once procedures are known, continue by preparing the team. Each reviewer needs to understand the refined evaluation criteria. Promote common understanding by reading, examples, and discussion. Every member of the review team needs access to the methodology data. They’ll need to know what it is and where to find it.

- **Profile the Methodologies**

  Carry out the review by examining one methodology at a time. A review form or worksheet is an effective way to organize the review and record review results consistently. When reviewing a method, first get a broad view by developing the descriptive information. Write a brief abstract, describing the methodology’s source, degree of formality, and readily apparent distinguishing characteristics.

  Add depth to your understanding of the methodology with sufficiently detailed examination to complete the checklist of deliverables categories. Investigate the results that the methodology produces
for each category of deliverables described in the checklist above, and determine whether each is a product of analysis, of design, or of construction.

Further review the methodology knowledge and investigate activities, deliverables, and structure to determine a rating for each of the review criteria. Criteria ratings are hard, measures of things that are sometimes soft and subjective. Reviewers can only record their perceptions and beliefs, and ratings will only be as accurate as the criteria descriptions and the methodology knowledge allow. We recommend a simple three point rating scale where:

(3) Indicates that the methodology exceeds expectations for the criterion.
(2) Indicates that the methodology meets expectations for the criterion.
(1) Indicates that the methodology does not meet criterion expectations.

This simple scale avoids complexity and minimizes uncertainty as reviewers rate the methods. Yet is sufficiently robust to support short-listing and selection needs. The ratings must be distinct and precise. On a three point scale, only values of 1, 2, and 3 are allowed. Do not permit fuzzy ratings like “1.5.”

During the course of each review the deliverables checklist was completed and criteria ratings were developed. To perform these activities, reviewers expanded their understanding of the method and its characteristics. Complete the methodology profile by returning to the abstract and refining it to reflect this expanded knowledge. Add to the abstract any important discoveries about the methodology that occurred during the review. Consider the following questions:

- Did you discover any significant strengths or weaknesses that should be noted?
- Is the methodology coherent and readily understandable?
- Are there particular key features of the methodology that deserve special attention? Any that meet particular needs of your organization?
- Does the methodology have an especially unique structure?
- Is the terminology uncommon or different from other methods?
- Are there any deliverables that deserve special attention?
- Should attention be called to any of the methods techniques or heuristics?
- Are there any notable properties of detail, rigor, or cohesion? Any significant gaps?
- Are there notable tool dependencies?

Completion of this activity produces a single methodology profile.

- **Consolidate Profile Results**

  Complete the review by compiling all of the profiles into a single collection of methodology knowledge. In addition to the collection of individual profiles, the set of knowledge looks across the set of methods to include such items as:

  - An overview of the list of methods that were studied.
  - Summary of common characteristics found among the methods.
  - Summary of significant differences among the methods.
  - A comparison chart showing relative completeness in each deliverables category.
  - A comparison chart illustrating all criteria ratings for all methods.
  - Consensus rating of methods rated by multiple reviewers.

  This activity completes production of the **methodology knowledge** deliverable.
Short List Development

This step produces a short list of two to five methodologies that is forwarded to the selection phase. A list of more than five is too large for systematic selection, and begins to replicate the evaluation process. A list of fewer than two will produce one of two outcomes – premature selection, or no selection.

The purpose of short-listing is to decide which few methodologies will be seriously considered for selection. It is an iterative process of affirming strong candidates and culling weak candidates based on the selection criteria and critical success factors. Affirmation positively asserts that a method should be considered for selection. Culling is a negative response to a method, excluding it from consideration for selection.

Careful selection involves a detailed, close-up look at each method, perhaps including some hands-on practice. The careful review needed for selection is both time-consuming and labor-intensive. Little benefit is derived, and significant cost is incurred, by performing such detailed evaluation of weak candidates. Short listing limits the selection process to rigorous assessment of a small number of strong candidates.

Short-listing produces a single primary deliverable – the short list of methodologies that is forwarded to the selection phase – and a secondary deliverable of selection candidate knowledge for each short-listed method. The short list is a subset of the candidate list that is input to the evaluation step. The selection candidate knowledge includes:

- The methodology profile developed during the methodology review step.
- A brief statement of reasons that the method is included on the short list.
- A summary of any significant strengths, weaknesses, features or other considerations that may be distilled from the collection of methodology knowledge.

Short-listing uses two inputs:

- The methodology knowledge from methodology review provides the set of methods, and the essential facts about the methods that are needed to select a subset. The ratings of methods against criteria are objectively applied to develop the short list. Other profiling information may be applied subjectively, and full profiles of the short-listed methods are forwarded to the selection phase.
- The selection criteria from the criteria review step identify “top ten” criteria and critical success factors needed to affirm methods on the list and cull methods from the list.

To apply the inputs, first establish the target size of your short list. Within the guideline of two to five methods, you may want to become more specific (e.g., your organization calls for a list of exactly three). Second, review the collection of methodology knowledge as a team. Each team member needs to be familiar not only with those methods that they reviewed, but also with those reviewed by others. Finally, apply the criteria ratings to execute an iterative process of affirming and culling methods until a list of the desired size is produced. Figure four illustrates a multiple pass procedure by which a short list may be achieved. This procedure assumes the three point rating scale described earlier. The first pass performs both affirms the strongest candidates (rated 3 for all critical success factors) and culls the weakest candidates (rated 1 on half or more of top ten criteria). Subsequent passes may affirm or cull as indicated by the size of the remaining list.

Producing the secondary deliverable – selection candidate knowledge – is relatively quick and easy. The knowledge exists as a result of previous activities. It simply needs to be compiled and packaged as a deliverable. A final pass to confirm all candidates on the short list and compile the candidate knowledge completes the short-listing step.
### Conclusions

We have introduced a process intended for use by IT organizations needing to implement and practice a formal approach to data warehousing. The process is designed to begin with general criteria for evaluating data warehouse methodologies (Figure 1) and to end with successful implementation of a warehousing method. The process is segmented into three phases—evaluation, selection, and practice. This article describes the evaluation phase in detail.

The evaluation phase produces three significant results. Each result is passed to the selection phase and used as follows:

- Selection criteria are used during selection to guide the choice of a single methodology.
- A short list of methodologies provides the selection phase with the set of candidates from which a choice is to be made.
- Knowledge of the short-listed methodologies provides the basis for the final selection.

The process that is presented here adheres to, and seeks to illustrate the very criteria that it provides the means to apply (except *data warehousing enabling criteria*, as it is not a warehousing process). It is results oriented, and achieves a high level of cohesion among results. It is specifically designed to be adapted to unique needs and cultures of each organization in which it is applied. And it is flexible enough that it may be adjusted and applied for non-warehousing processes of the IT organization.

### A Look Ahead

The next article in this series details the process phases beyond selection of a methodology—selection and practice. We will explore those phases in depth, and discuss the challenges an organization faces for implementation, institutionalization, and continued practice of data warehousing methodology.

The Data Warehousing Institute (TDWI) plans to evaluate several existing and emerging data warehousing methodologies. This evaluation will be based on the general criteria presented in the first article, and performed using a subset of the evaluation phase described in this article. Evaluation results will be available in a TDWI research report, and may be the subject of future *Journal of Data Warehousing* articles.