Cradle-7
From concept to creation...

3SL

Overview

Cradle is an integrated requirements management and systems engineering environment with the features, flexibility and scalability for the full lifecycle of today's complex agile and phase-based projects.

From concept to creation, from Cradle to grave.

Cradle is unique. It provides the tools and features to create and manage all your data, at all stages in your systems development, and at all levels. By managing all the data in one place, only Cradle can provide traceability across the entire lifecycle in one tool. Without Cradle, you have to assemble many products from many vendors, and you will still not have the full traceability that Cradle can provide.

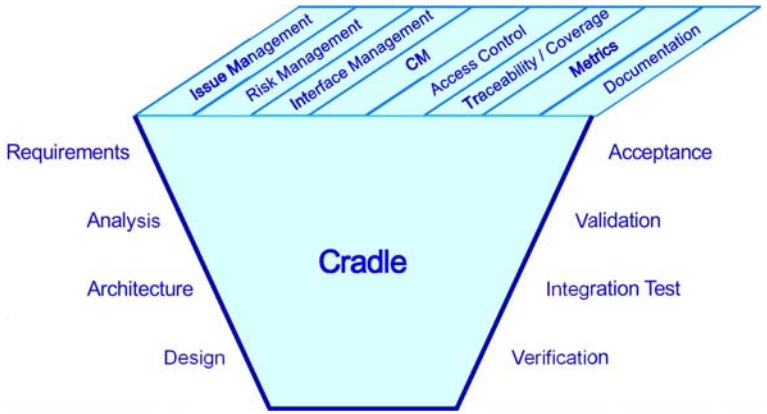
Cradle provides full requirements management, analysis, design, architecture and performance modeling, test, risk and interface management and metrics in one product. You can use all of these facilities, or combine Cradle with tools from other vendors. If you have such tools then Cradle will link to them, extending their scope from a part of the system lifecycle to all of it.

Cradle is multi-user, multi-project, distributed, open and extensible. It links to your existing desktop tools to create a tailored environment to suit your process.

Cradle provides built-in issue, risk and interface management. It supports comparative trade studies and analyses. Cradle provides a built-in configuration management and control system with baselines, version control, change histories and formal change control. It bidirectionally links a WBS and progress reporting to your project planning tool. With these capabilities, Cradle removes the need for you to try to connect risk, CM or change tracking to systems engineering. Cradle provides everything you need, integrated and ready to use.

Cradle has customizable, hierarchical, access control facilities and integrates with your authentication, access control and security mechanisms including firewalls, LDAP and SSL.

Cradle provides user-definable views of project data, tailored to each stakeholder group. With customizable navigation, review and entry tools and tailored web UIs, Cradle shows each user the data that they want to see, in the way that they want to see it.



Projects use user-defined, arbitrarily extensible databases, linked to external files, URL resources and data in external repositories. Each database is configuration controlled, with change histories, baselines, versions and variants, managed by configurable change requests and change tasks.

Cradle supports off-line and remote access from geographically separate groups. Internet and VPN access is provided, with full support for project and company firewalls and DMZs.

Cradle connects dispersed teams together, with tailorable discussions, alerts and e-mail.

Cradle is modular, using floating licenses to share resources dynamically across the project.

Cradle-PDM provides a project infrastructure, from access control and user accounts, through a user-defined schema, phase hierarchy, team hierarchy and access controls to configuration management and open external interfaces.

Cradle-REQ provides

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requirements management from external source documents to baselined, engineered requirements linked to the rest of the system lifecycle. It allows you to define and manage user stories, validations, test cases, and any other types of information for all of your process.

Cradle-MET provides user-definable metrics to gather and analyze statistics for your data.

Cradle-SYS is a flexible analysis and design modeling environment. It allows any number of models to be built and grouped into model hierarchies in distinct analysis and design domains. Models are fully cross referenced to requirements and all other information.

Cradle-DASH provides user-definable Key Performance Indicators (KPIs) calculated from live project data in user-defined dashboards shown as tables or dials.

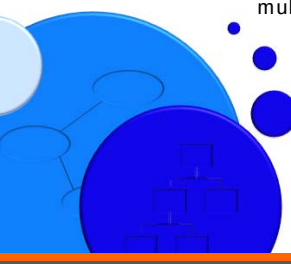
Cradle-PERF provides performance assessment, budget apportionment and data aggregation facilities for design models at any level in a system development.

Cradle-SWE provides code generation and reverse engineering for C, Ada® and Pascal, to synchronize design and source code.

Cradle-DOC provides user-defined project document generation and a formal document register of project deliverables.

Cradle-WEBP provides web publishing of project data to static, hyperlinked, websites for external stakeholders.

Cradle-WEBA allows read-only and read-write access to project data through multiple, user-defined, web UIs that are tailored to each stakeholder group. It provides external access to Cradle items through URLs.



Feature Summary

Feature	Benefits
Single integrated environment	Supports entire lifecycle in a single environment, no need to interface requirements to design or test tools
Process independent	The flexibility to tailor the tool to your process, not the reverse
Process support	Embed your process into the Cradle UI, to simplify use, and reduce need for training
Agile and phase-based processes	Supports agile, highly iterative processes, and those using longer phases and phase gates
Full integration of RM, MBSE, V&V and project management	Develop needs, user stories, use cases, logical models, requirements, link to architecture and design models, then link to V&V and manage with your PM approach, such as WBS, SBS, CBS, house of quality and others
Full lifecycle traceability	Allows full end-to-end traceability and coverage analysis across the entire lifecycle from a single tool
Integrates management activities	Provides built-in support for all transversal issues, including issue, risk, test and interface management
Integrates project planning	Bidirectional links exchange WBS and actual start/finish dates and progress with external planning tools. Users have individual task lists that automatically update over time and are linked to project data.
Document generation	Generate complete, accurate and consistent documentation for the entire project from a single source
Progress tracking and metrics	Provides built-in metrics support to track all project activities and products
Arbitrarily extensible databases	Project schema defined by point-and-click UI, changed at any time, support smallest or largest of projects
External database linking	Connect Cradle database to external data sources, as files, URLs and in other environments
Baselines and change control	Supports evolution of database contents through integral configuration management and control system with full change tracking of all edits
Comprehensive access controls	Controllable authentication, access control and project organization structure, will protect project data whilst supporting distributed work groups and the integration of customers and suppliers into the project
Robust, multi-user environment	Cradle Database Server (CDS) accommodates systems with millions of items and 8,192 concurrent users
Flexible interface mechanisms	Link Cradle to existing tools to preserve your investment
Integrates with all desktop tools	Predefined integrations for Microsoft Office® and other standard tools
Flexible remote user support	Remote access through web and non-web facilities, with a fully controllable TCP/IP environment and SSL
Floating, dynamic licensing	Efficient use of licenses for minimum cost of ownership
Supports Windows and Linux	Freedom for host platform for clients and servers, take advantage of the strengths of each
Complete interoperability	Run any part of Cradle on any platform, move data freely between them
On-line manuals and help system	Fully web-based on-line documentation, fully searchable, with task-based help, a comprehensive index and technical reference
Active support program	Expert help and guidance when you need it from a support team that cares
Regular updates	Prompt solutions to problems and a continual program of extensions and upgrades that works at your pace to match the needs of your project
Active consulting program	Strategic process/project planning, mentoring and on-site support

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Cradle-PDM

The **Cradle-PDM** module provides the infrastructure for all other Cradle modules. Its scalability and flexibility create an industrial strength, proven, shared data environment for even the largest projects.

Cradle supports any number of databases, each with its own schema, CM system and users. Each database supports many projects. Use the Project Manager tool to organize this environment by user-defined criteria, for example as hierarchies.

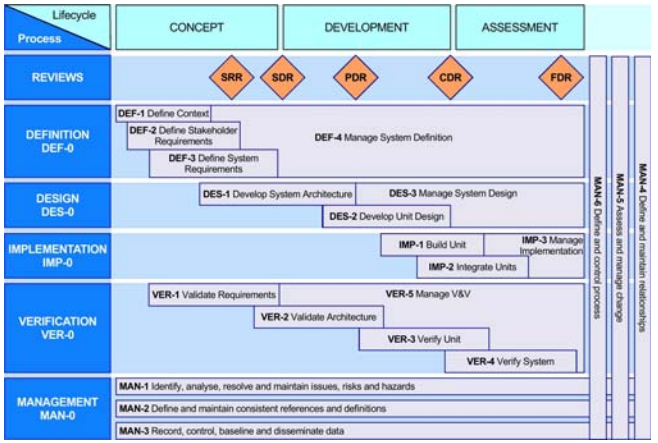
Each database stores any number of items, of any number of types (requirements, risks, classes, user stories, functions) defined by a UI. Items have any number of attributes, each of a user-defined type, that manage up to 1 TByte of any type of data, held in Cradle, or referenced in external files, URLs or another tool or environment.

User-defined calculations are supported in all parts of Cradle and can be displayed as graphs, in views and user-defined reports. User-defined rules can be applied to automatically set attribute values or perform calculations, to maintain the integrity within and between items.

Items can be cross referenced, with optional user-defined link types and groups. Links have user-defined attributes to justify, parametize, explain or characterize them. You control which links are used to navigate or report traceability, based on link type or group, direction and link attribute values. Links are both direct and indirect, for full lifecycle traceability, impact and coverage analyses.

You use start pages and a phase hierarchy to build an environment tailored to your process. End users only need to be trained in your interface, reducing training time and costs:

- Start pages are text and graphics controls that perform your choice of operations simply and easily
- The phase hierarchy shows the process as a hierarchy in which an agile or phase activity, task, sprint, report or document is run by a mouse click. Different parts of the phase hierarchy can be shown to each user or stakeholder group.



Traceability and coverage views are available as trees, nested and pivot tables, matrices and Hierarchy Diagrams. Unique transitive links give traceability across the full system lifecycle.

Items evolve through versions that exist in baselines and controlled by a built-in CM system, with mechanisms for review, baseline and version control, full change control, and audit trails.

Cradle can track all changes. Edits can be reversed selectively or by group. Items can be compared across edits and in baselines. Edits can raise alerts to users, and mark related items as suspect. All edits are permanently available, for change logs.

Cradle provides adaptations to allow variants of items. This mechanism is ideal for databases that contain a library of standard items and projects that use the library, and contribute to it.

Access controls apply to all items based on user roles, privileges, security clearances and skills. Users can be grouped in a hierarchy of teams, to create any access control scheme. The creation and manipulation of links can be controlled, by item or user.

Cradle is multi-user. It locks information per item, with automatic database commit after edits. This maximizes users' interaction with the database and guarantees all data is up-to-date.

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Cradle's alert mechanism sends messages by e-mail (SMTP or IMAP), Cradle or both. Alerts can be enabled and disabled. Alerts track events on items, including edit, review and formal change.

The Cradle discussion mechanism allows even read-only users to add comments to items. There are 4 other commenting mechanisms.

Cradle can manage project plans and WBS. User task lists are maintained. The WBS and progress data can be bidirectionally exchanged with external PM tools. Cradle can generate burn-down and earned-value graphs on any user-defined criterion to monitor progress.

Cradle is open and extensible. It has multiple import/export formats, an API, a user-defined event-driven command interface, links to other tools and bidirectional links to Microsoft Office®.

Cradle provides uniquely powerful data query and visualization facilities. Each user's setup can be tailored by defining custom queries, views, forms, navigations, matrices, reports and other facilities. All customizations have a scope, to be specific to the end user, or shared with other users of the same type (such as all customers or all managers), the user's team, the entire project, or all projects.

Any compliancy, coverage or traceability report can be created quickly/easily using Cradle's queries, multi-row views/nested table views, & saved for later use.

Cradle has floating, dynamic licensing and low cost read-only users. Open and named user licenses are available. Everything described here is free of charge.

Licenses, databases and schemas are identical across Linux and Windows 8.1, 10, 11, Server 2012 R2, 2016 and 2019.

Feature Summary

Feature	Benefits
User-defined process / phase hierarchy	Represent project's process or database views in the Cradle UI, to reduce or eliminate end user training and avoid the need for users to be Cradle experts
User-defined database schema	Any agile or phase-based process can be represented in your Cradle environment
Infinite capacity, distributable database	Cradle scales to accommodate the changing and growing needs of your projects, easily supporting projects with over 1,000,000 items and 8,192 concurrent users
User-defined item and attribute types	Store, manage and link any types of data so all aspects of the project are traceable and controlled
Fully multi-user	Maximum collaboration between multiple users, groups and sites. No complex access control problems.
Full range of basic data types	Accurately represent dates, integers, reals, single/multiple value pick-lists, and plain and rich text
Flexible data storage	Use Cradle to manage data held in Cradle, in external files, in external tools, or at URLs
Automated data integrity rules	Automates your process rules to set attributes based on other attributes' values, or perform calculations
User-defined link types and attributes	Record multiple types of relationship; all links have attributes to characterize and explain relationships
User-defined link rules	Control all operations on links, based on item and link types, and optionally users and groups, ability to set link cardinality
Cross reference Hierarchy Diagrams	Graphically view and manipulate cross references, from source documentation to requirements, analysis and design models, verifications, risks, interfaces and to all other information in your process
Nested tables, pivot tables, matrices	Comprehensive traceability and coverage analysis facilities
User-defined calculations, summaries and burn-down / earned-value graphs	Calculate any desired values from project data, such as level of effort, cost, time, weight or power consumption. Automatic sub-totals. Results can be reported and graphed. Ideal for management summary information and project reports.
User accounts, teams, skills and security levels	Represent any project organization, including external groups, and define an access control scheme that provides the correct level of access by each user and group to each part of the database
Full change histories	Record of all changes made to information (who, what, why, when) with options to reverse or rewind
Configuration management and control	Control the development, review, baseline and formal change of all project data, with full audit records. All processes are controlled by user-defined workflows.
Integrates with project planning	Bidirectional exchange of WBS and actual progress data. Individual user task lists linked to project data.
Automated alert messaging	Automated notification and communication within the project team, by Cradle and through e-mail
Discussions	One of five commenting mechanisms, particularly suited to read-only users, particularly for web access
Open and extensible	Variety of import/export, command-based, API and event-driven interface mechanisms. Support for Cradle, CSV, XML, ReqIF and other exchange formats. Specialist integrations with Office® and other tools. A Web Services Interface (WSI) REST-based HTTP API.
Data and platform interoperability	Deploy Cradle components on any Linux or Windows platform and have full interoperability and data compatibility with all other Cradle components on the same or any other platform.
Floating and dynamic licenses	Licenses dynamically shared between users to maximize license sharing and minimize license costs

Optional support for Oracle and MySQL.

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Cradle-REQ

The **Cradle-REQ** module provides a complete requirements capture and engineering solution with built-in CM. It can manage needs, risks, products, features, tests, validations and any other data. It is easily applied to both agile and phase-based processes.

Requirements management is part of every agile and phase process. Stakeholder needs are captured, analyzed and engineered. Changes are tracked in a CM system. All needs will be linked to design, build, test and acceptance information. In agile, this is in every sprint. In phase-based processes, it is less frequent. But the techniques are the same, and the same tool needs apply that only Cradle provides:

- User-defined information, attributes and links
- Data query, view and manipulation features
- Built-in quality checks on items' contents
- Integrated modeling
- Built-in collaboration, discussions and alerts
- Built-in configuration management (CM) with baselines and formal change (CC)

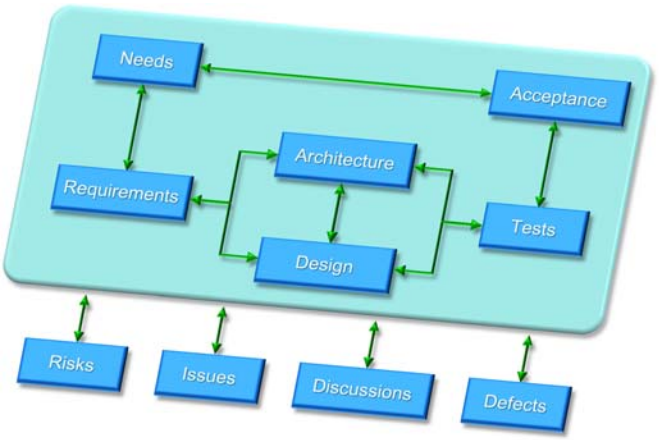
You can define requirement types (user, business, system, product, functional or non-functional), user stories and use cases. You link to codes, standards, regulations, knowledge or assumptions. You define other item types to be managed, such as functions, issues, tests, risks, SBS, PBS, WBS or defects. You control the attributes in these items, how they will be linked to each other, and their workflows.

Items have user-definable attributes, each storing or linking to up to 1 TByte of data. Attribute types are user-defined, including dates, numbers, plain and rich text, single or multi-value lists, Office® and other documents, and calculations.

The text in requirements, tests, verifications and other items can be quality checked against project-specific rules.

Items can be in hierarchies, groups and many:many relationships. You can create projects using a common library. Product ranges, models, variants and builds are supported. Items can be shared and reused in any of these structures.

Items can be captured from external documents by Document Loader. It reproduces the document structure in a hierarchy of items. Each item is linked to its origin in the document. Figures are loaded automatically. Tables can be captured into items, images, Word objects or rich text.



Document Loader finds differences in new versions of documents. Loading the new version will update items and their links. Coverage analyses between documents and database items are provided.

Full version management of source documents is provided. Regression to previous versions is supported, with reversal of all changes.

Requirements and other items can be loaded from Word®, Excel® or other tools using plug-ins, data exchange or direct interfaces.

Coverage, traceability and impact analyses are easily run, then viewed as trees, lists, tables, matrices or in dynamic Hierarchy Diagrams with user-defined attributes. Items can be filtered, sorted, split and merged. All changes to items can be logged. Users can be alerted to changes by Cradle, e-mail or both.

Users collaborate by adding discussions to items and adding threads of comments to these discussions.

Once stable, items can be progressed through a series of formal reviews that log comments from all reviewers. You define the

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workflows. Once in a baseline, items can be subject to formal change control using change requests (proposals) and change tasks (actions). You can view the database as it was in any previous baseline.

Multiple generations of requirements can be maintained and compared. Multiple sets of variants can be managed to reflect different products in a common family.

Items can be progressed within their lifecycles. The lifecycle of an item represents the series of stages that it can pass through between being created and reaching a final, rest, condition.

User-defined tree, table and matrix views can be defined from a point-and-click UI to show traceability, coverage and compliance. This includes RTMs, VCRMs and PVMs.

Cradle provides transitive cross referencing, in which it follows chains of multiple links between indirectly linked items, so you can see cross-lifecycle traceability in one step. For example, you can view user requirements to tests, where Cradle transparently follows intermediate links via system requirements, functions, architecture components and so on.

Requirements can be linked to test data, safety and other critical issues, risks or any project data. When used with the **Cradle-SYS** module, user stories and requirements can be linked to functional, behavioral, UML, analysis, architecture and design models organized into any number of model hierarchies in both analysis and design domains.

- All information can be published in user-defined reports and formal documents.

Feature Summary

Feature	Benefits
Automated requirements capture from source documents	Load customer documents directly into Cradle, preserving hierarchical structure, figures and tables, with direct links from each captured requirement back to its source statement in the original document
Excel capture	Capture requirements and other items directly from spreadsheets, with data validation
Capture from Word documents	Capture requirements and other items directly from Word documents using the Document Loader tool
Data exchange with other tools	Exchange data efficiently with customers, partners and suppliers
Automated comparison of source document versions	Automatically find changes in new versions of source documents, with immediate impact analyses of the effect of each change and automatic update to the edit histories of items affected by each change
User-defined attributes	Customize the requirement types to the project needs
Manage rich data	Attributes can store or reference any type of data, held in Cradle or linked to external files, URLs or to data held in other tools, such as document management systems
Requirements groups, categories	Tag, group, sub-group and organize requirements to meet any need
Support multiple variants	Support typing and sub-typing, such as products in a product family, variations on a single product
Requirements engineering	Comprehensive engineering facilities (including search, group, split and merge) to find and correct deficiencies in requirements sets, including ambiguity, contradiction, duplication, and omission
Automated quality checks	Check the quality of requirement statements using user-defined rules and lists of good and bad phrases
Graphical hierarchies	View and manipulate cross references in dynamic Hierarchy Diagrams, with full control over which information and relationships are shown, and which attributes of requirements and other items are displayed
Table and matrix display styles	Easy manipulation of requirements and other items
Compliance tables	Nested tables using direct or transitive cross references to show coverage and traceability analyses
User-defined views and forms	Customize display of requirements through point-and-click UI, provide custom views and forms for specific users and user groups
Direct editing	Individual locking of each requirement allows direct editing through forms and allows multiple users to concurrently edit through table views
Find and replace	Find and replace text in selected items, or all items matching a query
Immediate commit	Changes are immediately committed to the database, no separate commit step, so all users automatically see the latest information in the database
Full evolution history	Maintain complete records of how the requirements evolved, by whom, when and why, supplemented by formal configuration management with versions, baselines and change control
Full lifecycle traceability	Allocate requirements to system architectures, functions and design items in analysis and design models, create mappings to test and acceptance data, project risks, safety, verifications and any other item types
Completeness and impact analyses	Find the impact of any change in external documentation or requirements, or find the impact on requirements or external documentation of any change elsewhere in the database
Robust, multi-user environment	Accommodate systems with millions of items (including requirements) and up to 8,192 concurrent users

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Cradle-MET

The **Cradle-MET** module provides the means to define metrics on the needs, requirements, user stories, features, models, tests, and all other systems engineering data in your project, and to run these metrics to monitor your progress.

Every project uses a process to create, review and publish its objectives, operational concept, sets of requirements, architecture and design models, and other systems engineering data. These processes will include management reporting, quality checks and routine audits of the volume of work that has been completed, and the completeness and quality of this work.

Metrics are a means to measure characteristics of your project data by collecting information about the materials created at each stage in the process. For agile projects, these characteristics will be analyzed at the start and end of each iteration or sprint, and in phase based processes, the analyses are likely to be weekly or monthly as part of normal project management activities.

Metrics are user-defined sets of calculations that can be run from the user-defined phase hierarchy and start pages, from the metrics tool's own UI, as a report, or from a command-line utility.

You can collect metrics on any of your project data. This includes requirements, use cases, functions, architecture components, models, interfaces, issues, risks, features, test specifications, test results, verifications and any other information generated by the systems engineering process.

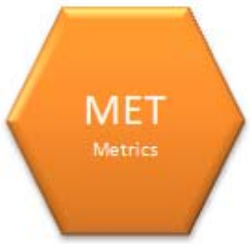
Each metric contains any number of elements, each of which is the combination of a query that finds the information in the database to be analyzed, and an analysis to be performed on this set of items found by the query.

Each metric element can use a simple query, or a complex query that nests one query inside another. The items found by the query can be counted, or the metric can perform a coverage analysis of the values of all of their category codes, or it can perform a calculation on the values of one or more attributes, including those attributes that are the results of other user-defined calculations. The results of these operations can be grouped in up to two levels based on the values of other attributes. You can also calculate weighted totals and means of a set of values. This can be used to calculate compliance of responses to a RFP or ITT. Basic calculations can be performed which are based on the results of other metric elements.

Metrics can also include pivot tables, which are a special tabular display using two of the items' attributes' values as rows and columns where the cells show the number of items from those found by the query that have each pair of values for these attributes.

If a pivot table is shown in the UI, the cells in the pivot table become links. Selecting a link displays the items that have that pair of attribute values. Thus, users can decompose the totals shown in the pivot table's cells into lists of items with the corresponding attribute values.

The results of running a



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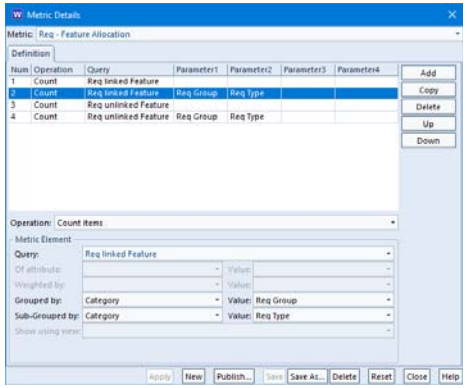


metric can be shown in Cradle web UIs and in the WorkBench UI. They can also be generated to RTF, HTML and CSV files and loaded into a variety of tools including web browsers, Word® and Excel®.

Access to the metrics tool can be controlled, to ensure reliable metrics are produced only in project-approved contexts.

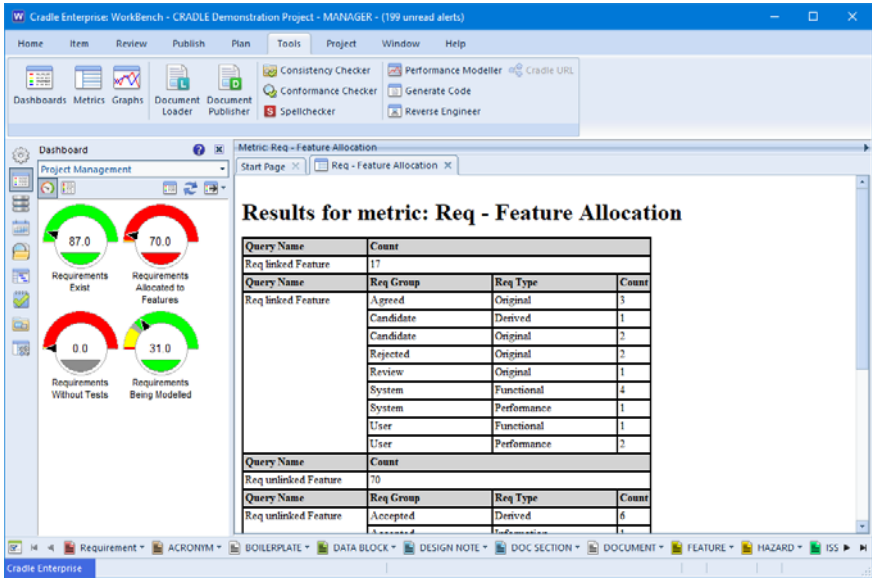
This mechanism allows projects, for example, to monitor the completeness of sets of needs or requirements, the completeness of their cross reference linkage, or the volume of data generated by specific project groups.

Metrics can be generated from any project baseline(s), allowing cumulative statistics to be created as the project develops. You can view the database as it was at the time of any historic baseline, and generate metrics from that baseline.

Metrics can be referenced from within KPIs in dashboards using the **Cradle-DASH** module.

Feature Summary

Feature	Benefits
User-defined metrics	Monitor any aspect of the project and the project's process
Run from user-defined UIs	Access from phase hierarchy in custom web UIs and WorkBench ensures metrics are easily run by all users
Run from command line	Automate production and distribution of project metrics
Coverage analyses	Full analysis of the numbers of items with each of the values of each user-defined list attributes, including unset values and values not found in the lists
Basic calculations	Perform basic calculations on the results of other metric elements
Flexible calculations	Compute results using the count of items, or values of items' attributes and items' embedded calculations
Calculations of calculations	Can create complex calculations by using calculation attribute and metric results in other calculations
Weighted calculations	Calculate weighted totals and means using a set of data values from one attribute of the items, and a set of weighting factors held in another attribute of these items
Pivot tables	Easily understand the distribution of items across the values of any two attributes, and the values' coverage
Pivot table drill-down	Easily explore the sets of items with particular combinations of attribute values
Customizable output	Easily generate reports with project-standard formats and layouts
Output to HTML, RTF and CSV	Easily generate output in common formats for common tools
Batch mode	Once defined, metrics can be published as reports from the command line, optionally in batch jobs



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Cradle-7
From concept to creation...

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Cradle-SYS

The **Cradle-SYS** module provides an analysis, process, architecture and design modeling environment that, being linked into the systems engineering lifecycle, provides full traceability and coverage for all model information. You can use SysML, UML, ADARTS, SASD, eFFBD, IDEF, BPM and other notations to achieve your MBSE goals.

A model is an abstraction of an aspect of a system being developed. Therefore, models should not be separate from the needs, goals and objectives that the model seeks to satisfy, nor from the tests that validate the system's compliance. Hence Cradle integrates modeling into all requirements and other systems engineering data, so every component of every model is traced to the highest level user need and to the lowest level test result.

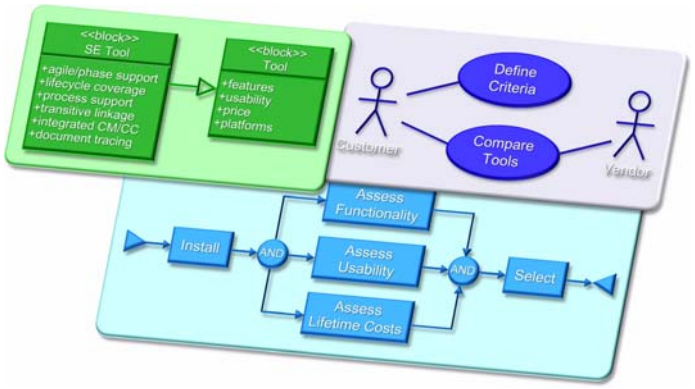
This applies to agile and phase-based processes. An agile process has no less need for models simply because its iterations are short. To neglect rigorous design in agile projects will ultimately compromise the system if a clear design is not modeled at the outset and maintained through each iteration.

Each Cradle database provides analysis and design domains. Each domain can contain any number of models, optionally organized in hierarchies. Models can be used to represent concepts such as:

- Alternative missions in a CONOPS
- Products within a range
- Regional variants of a product
- Comparative analysis of architectures

Each model contains any number of diagrams from a wide variety of notations. Each diagram contains symbols, and each symbol is described by a data definition or specification.

All diagrams, specifications and data definitions in a model can be cross referenced to each other and to information in other parts of the lifecycle. So user requirements can be linked to use cases, that are linked to system requirements, that link to a logical model of system behavior, that can be allocated to a logical architecture, which can be allocated to multiple physical architecture models for assessment.



A System Breakdown Structure (SBS) is useful as an abstraction of the system composition, and as a single structure to which all the requirements can be linked. The alternative system architectures and designs can be explored, each in its own model, all linked to the SBS. This simplifies traceability for the requirements and the performance constraints, without restricting the modeling activities.

Models can link to a Product Breakdown Structure (PBS) to allow linking to a PLM environment.

Cradle has over 20 diagram notations from methods including UML, ADARTS, IDEF, SASD, SysML and data, process and architecture modeling. The notations can be combined when semantically viable. Cradle does not limit you to one method, nor constrain your choices for the notations that will best express the system for the audience of that model.

Cradle provides a consistent, interface to building diagrams. It includes time-saving features to build diagrams in time-sequenced notations, such as Process Flow Diagrams (PFDs) and extended Function Flow Block Diagrams (eFFBDs).

In hierarchical notations, Cradle has a range of features to build both child and parent diagrams that are automatically consistent.

Cradle enforces diagram syntax when editing. Completeness and I/O consistency checks are provided, both within a diagram and between diagrams to ensure the conservation of data and

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function. Cradle also checks the consistency of diagram graphics and text descriptions. For notations that use it, Cradle provides a full Data Dictionary with a formal BNF notation to describe data composition.

In architecture models, Cradle supports data protocol descriptions across interfaces and can generate message formats (bitfields) that describe the formatting of the messages in all data exchanges.

Diagram symbols can be colored with embedded graphics, so they are easier to understand.

Notations can be combined, such as UML and other diagrams in a model. Some notations can be used in other ways. For example Sequence Diagrams (SQDs) can show message protocols across an architecture model interface, their role in SDL before their use in UML.

All model elements can have graphics, video, figures, tables, equations, URLs and integrate with tools such as Visio®, Word® and Excel®. Each diagram, data definition or specification is an item in the database and so can contain any number of attributes each containing, or referencing, up to 1 TByte of any type of data.

Models have change histories, discussions, comments, are formally reviewed in Cradle's CM system, and can be baselined.

Models can be printed to a variety of devices. They can be part of user-defined documents with requirements, tests and other information. Models can be published in static, hyperlinked websites that provide links between diagrams and between symbols and the descriptions. All Cradle web UIs support viewing and navigation of models.

Models can be loaded from other tools by import or data conversion from other tools' data formats or XML.

Feature Summary

Feature	Benefits
Separate analysis and design domains	Separate implementation dependencies from essential behavior
Any number of models	Define model structures suited to the project, such as mission analyses, analysis of alternative system architectures, or model multiple variants of multiple types of multiple products
Fully linked into the lifecycle	Link models to source requirements, features, tests, risks, issues, verifications and any other items, and link to a SBS and/or PBS to correlate information with non-modeling tools including PLM
Wide range of functional, object, data & architectural / physical notations	Not limited by SysML, UML, ADARTS, IDEF or SASD, use whichever notations are most appropriate and combine them when this is helpful
Multiple architectures and shared elements	Study multiple architectures and separate function allocations
Shared representation of diagram symbols	All uses of a data or behavioral component on any diagram share a common item in the database
Automated diagram construction	Create parent and child diagrams that are automatically consistent and balanced
Syntax checking editors	Diagrams and textual descriptions are immediately correct when created and edited
Comprehensive consistency checks	Absolute consistency of function, data and interfaces between diagrams and between diagrams and supporting text descriptions
Diagrams, specifications and data definitions have unlimited attributes	Model elements have unlimited attributes of any data type including plain and rich text, dates, numbers, single and multiple value lists, images, video, documents and any user-defined data types
Interfaces to other tools	Link to parts of PDF or Visio diagrams. Import/export from SVG, XML. Load from other tools including Teamwork, BPwin, RDD-100 and CORE.

Supported Notations

Methodology	Notations
SysML	Activity Diagram, Block Definition Diagram, Internal Block Diagram, Package Diagram, Parametric Diagram, Requirement Diagram, Sequence Diagram, State Machine Diagram, Use Case Diagram
UML	Use Case Diagram, Sequence Diagram, Collaboration Diagram, Class Diagram, Statechart, Activity Diagram, Package Diagram, Component Diagram, Deployment Diagram
Functional	Data Flow Diagram, IDEF0, extended Function Flow Block Diagram
Data	Entity Relationship Diagram, Data Structure Diagram
Dynamic	State Transition Diagram
Architectural	Physical Architecture Diagram, Architecture Interconnect Diagram, Software Architecture Diagram
Process	Process Flow Diagram
Source code structure	Structure Charts, Ada Structure Graphs
Organization	Hierarchy Diagram

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Cradle-PERF

The **Cradle-PERF** module applies user-defined calculations to an architecture model, to compare the performance of alternative architectures and apportion performance budgets to subsystem, component and equipment designs.

Simulation is an activity to reproduce a system's behavior in an artificial environment to test the system in a variety of scenarios. Simulation is used where testing the real system is either dangerous, impracticable or too time-consuming or expensive.

The most fundamental behavioral characteristics of systems are set early in the design process, as alternative architecture topologies are assessed and performance budgets are set. But as there is no behavior allocated to the components, it is not possible to build a simulation.

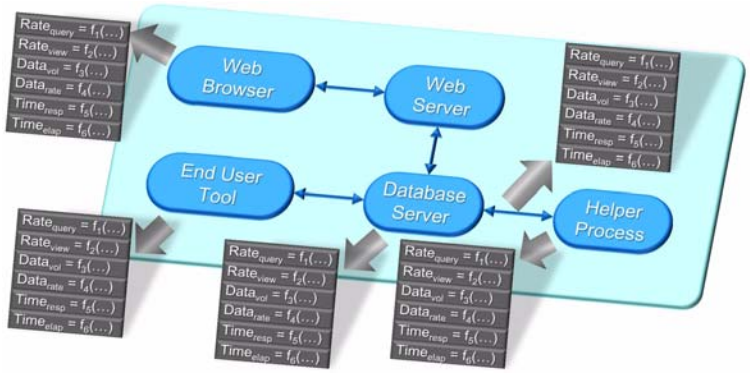
Performance assessment solves this problem. It is used before behavior is known and allocated and so before simulation can be used. It can be used to confirm if a proposed architecture is viable. It can be used to compare performance characteristics of candidate architectures. It can be used to define budgets for lower design levels (apportionment). Later, it can be used to aggregate actual values.

Performance assessment is expressed in user-defined characteristics, typically concerned with timing, data error or precision, such as:

- Bandwidth
- Utilization
- Size
- Cost
- Data rate
- Staleness
- Weight
- Power

They can be subdivided, for example to study best case, worst case and typical conditions. They are held as user-defined formulae in the specifications and data definitions of the symbols in the diagrams of the architecture models.

Any number of performance characteristics can be defined and associated with each diagram symbol. Each has its own formula. These are defined using a function library and user-defined calculation routines. This library contains logical, arithmetic, logarithmic, exponential, ladder, table lookup and interpolation routines, amongst others.



System performance requirements are applied as constraints to these characteristics by linking the items in the database and defining ranges of values for the performance characteristics that should not, or may not, be exceeded.

Analyses are run on state models that are sets of interconnected diagrams at appropriate levels in the architecture.

A state model can have external loads applied to it to represent different usage scenarios. An analysis can contain many such environmental loads. The environmental loads are defined as values of any of the performance characteristics at the external input(s) to the model.

Each analyses applies the environment load and calculates performance characteristics for all of the symbols in the state model's diagrams using the formulae and constraints in each symbol. The results are therefore quantitative. They are stored inside the symbols' descriptions.

The results can be reported in the same manner as other information in a Cradle database. They can also be graphed. The graphs will typically show the values of specified characteristics along a path through the model, termed a thread. Each graph will show any

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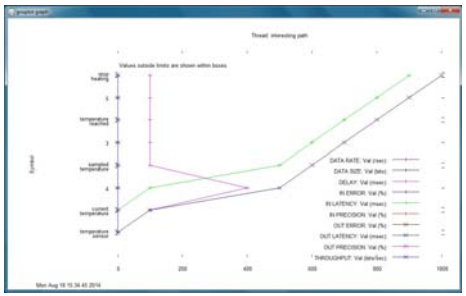
constraints applied from the system requirements and the effect of the constraints on the analysis results. The data in such



graphs can be exported to CSV.

Any number of such thread analyses can occur.

The results will show that an architecture is viable if none of its constraints are violated.

Since the performance data is built into the architecture model, any and all changes to the model's topology (such as a change to the architecture) will be automatically reflected in changes to the performance results. This allows easy comparison between alternative architectures.

The analysis results are the characteristics of a viable architecture. Hence, they are the constraints or budgets for the next level of design. So the analysis of each level produces performance constraints for the next level. This process can continue through the design levels until the system behavior is sufficiently well defined for simulation to be practicable.

Feature Summary

Feature	Benefits
Performance assessment based on characteristics of system behavior	Can be used before behavior is decided or functions allocated to identify performance budgets
Predictive tool	Defines constraints on each design level from the level above it
Arbitrary subdivision of characteristics	Study multiple situations and contexts simultaneously, such as best case, worst case, and typical case
Budget apportionment	Allocate budgets hierarchically downwards
Result aggregation	Aggregate results from lower levels to the higher levels
Constraint assignment	Limiting and advisory constraints to impose acceptance criteria and performance requirements on analyses
Arbitrarily extensible	Add any number of performance characteristics to analyses
Extensive function library	Pre-defined functions for all common operations including table lookups, step or ladder functions, linear interpolations, and linear, exponential and logarithmic expressions
Access to external functions and simulations	Embed any external calculation or simulation routine for complete flexibility
Multi-layer environmental effects	Build environment loads using a flexible three-tier approach, to test system failure conditions and explore maximum load criteria
Define models for analysis	Define appropriate architectures or subsets of architectures for study at any level of detail
Multiple analysis results held within the design	Allows comparative assessments of alternative architectures or alternative function allocations to, or within, subsystems
Change to the model change the performance	Any change to the topology of the architecture model will directly affect its performance characteristics without any need to change the performance analysis
Graphical output	Visually presents performance characteristics along threads for easy understanding of performance throughout the system
Cross referenced to entire database	Linked to performance requirements and acceptance criteria

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Cradle-7
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Cradle-DASH

The **Cradle-DASH** module provides the means to define Key Performance Indicators (KPIs) and their presentation as dashboards in web UIs, non-web UIs and reports.

Every project uses a process to create, review and publish its objectives, operational concept, sets of requirements, architecture and design models, and other systems engineering data. These processes will include management reporting, quality checks and routine audits of the volume of work that has been completed, and the completeness and quality of this work.

Key Performance Indicators (KPIs) are measures of the maturity of the information managed in the process, and therefore of the process itself.

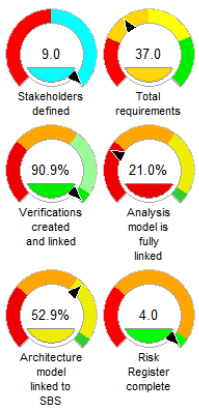
Cradle supports KPIs as a convenient means to provide an overview of the status of an entire project, or any phase within it.

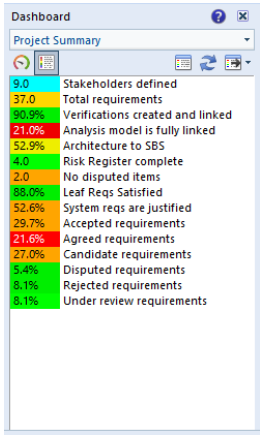
Any number of KPIs can be defined. Each KPI is a calculation based on one or more elements of one or more metrics:

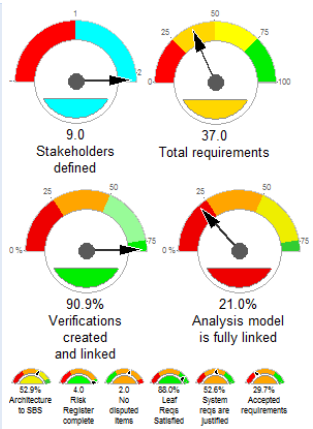
- Product
- Sum
- Difference
- Deduction
- Proportion
- Percentage

combined to produce a single numerical value. The component values are derived from user-defined queries, that are searches of database items, or searches of the links between these items, or both. The component metrics can:

- Count the values or calculate the total, mean, average, range or variance of the values from the items found by the queries
- Use values held in attributes or the results from user-defined calculation attributes
- These calculation attributes can use other attributes of the same item (this includes other calculations) and also attributes from linked items, such as calculating the total cost from the individual costs of a parent and its children







Any number of color-coded range bands can be defined for each KPI so that its value can be shown in a block with an appropriate background color.

Using colors for the KPIs allow the overall status of a project to be seen at a glance. Typically, anything shown in green is good, anything shown in red will need urgent attention, and anything yellow needs to be monitored carefully. It is easy to apply such 'traffic light' conventions in a KPI's color bands.

A collection of KPIs is held in a dashboard. Any number of dashboards can be defined, either personal to you, or shared with other members of your team, or shared with everyone in the project, or available to all projects.

Each dashboard presents its KPIs as a column shown either as a name and color-coded number, or as a dial. The size and display styles of the dials can be controlled for each KPI.

The dashboard can be published as a report, either as a table or as a set

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of dials. As for all reports, output can be to a file, a printer or the UI. Such dashboard reports are fully supported in web UIs, and non-web UIs.

The value shown in each KPI is a link. Selecting the value will display the list of items that have been used to create the KPI's value.

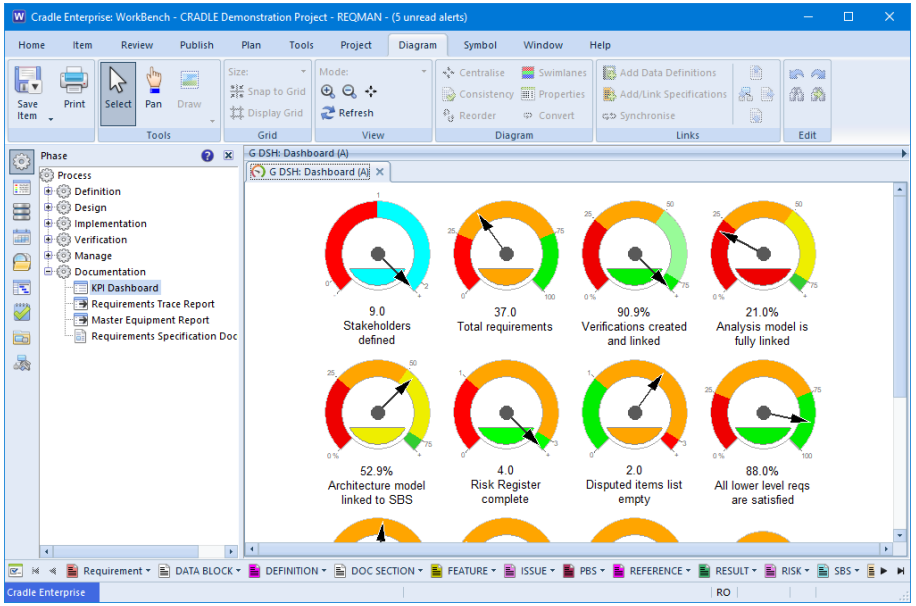
Dashboards are shown in a separate sidebar in both web UIs and non-web UIs. One dashboard can be set as the default, and will be shown automatically when the UI starts.

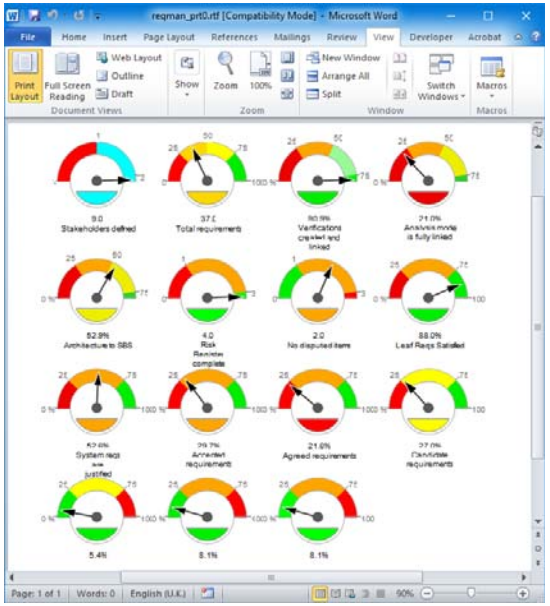
Custom web UIs could be created to show a collection of dashboards, for example to provide a simple overview of the project and more detailed analyses of the status of each work area.

Dashboards can be published to RTF, HTML and CSV files.

Feature Summary

Feature	Benefits
User-defined KPIs	Calculate values from user-defined metrics to monitor project status and progress
Flexible calculations	KPIs are calculated from the values of one or more metric elements, each of which can be a calculation that uses the values of attributes inside items, or the results of user-defined calculation attributes (which can themselves reference other calculations)
Color-coded values	Highlight the meaning of KPI values with user-defined color-coding bands
User-defined dashboards	Create groups of KPI values
Dashboard displays	Dashboards can be shown as dials and tables in separate UI sidebars in web-based and non-web UIs
Expand KPI values into items	Expand any KPI value into the database items that create the value to examine progress or analyze problems highlighted by the KPI
Publish as tables or graphics	Easily generate output in common formats (HTML, RTF, PostScript, SVG, CSV...) for common tools
Batch mode	Once defined, dashboards can be published as reports from the command line, optionally in batch jobs





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Cradle-DOC

The **Cradle-DOC** module generates documents by combining user-defined templates with items in the database. A document register and a correlation between documents and database items provides full traceability.

Projects use documents as sources of information (such as user requirements or regulations, codes and standards), as confirmation of agreement (such as a CONOPS or RTM or SRD) and to define interfaces between project teams or organizations (such as a SDS or SSDS). Often, a project's progress can be expressed as the issue states of its key documents.

Cradle can generate user-defined reports that will satisfy all internal project needs for information, including simple lists, compliance tables, change logs, traceability and coverage matrices. These outputs are produced from the report, view, query and matrix facilities of the **Cradle-PDM** module.

The Cradle Document Generation module exists to produce complete, high quality, documents directly from the database. It can publish documents that include cover pages, Tables of Contents, Lists of Figures, sections and subsections with mixtures of hierarchical paragraphs, bullet lists, figures and tables.

Any number of documents can be defined. Each starts as a Microsoft Word® document that has all of the internal structure, page layouts, styles and formats required. The Document Publisher tool is used to insert tags into this template everywhere that data is to be reported from the database. Each tag defines both the information to be published, and the high-level formatting to be used for this information, for example if it is to be published as a hierarchy of sections, a bullet list, or as rows in a table. The tags can follow cross references in any manner required, so complex relationships can easily be included in the document. The tags are defined through a UI, so that complex scripts are not needed.

Arbitrarily complex tables, hierarchies of sections and subsections, embedded diagrams, paragraph and section numbering and self-referencing within the document are supported, all specified within these tags and their associated descriptions.

At runtime, the Document Publisher uses the tags to query the database for information that is to be loaded into Word and formatted according to the styles, contents lists and indexes of that Word template. Embedded binary data can be loaded into the document, including any other Word documents and other binary content, including figures, spreadsheets and drawings.

Document templates can include user-defined variables that are specified at runtime so that a single template can be used to produce many different documents.

Any number of these templates can be defined and each used to generate many documents. Each document publishing operation will report either the current work-in-progress information or the contents of project baselines created with Cradle's built-in Configuration Management System.

Documents can be published from the Document Publisher tool's UI, or from nodes in a user-defined phase hierarchy UI, or the command line. This allows Document Publisher to be

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run in batch mode, for example to publish standard project documents overnight.

When Document Publisher is used to publish a document from a template and database, the resulting document can be marked as a formal document by specifying an issue, issue date and reference. In this case:

- A copy of the published document is held in the database so it can be provided in the future
- A record of the document is added into a formal document register, and
- Cradle records which instances of database items were used to produce the document

So when anything changes in the database, you know which formal documents contain the items that have changed, so you know which formal documents need to be re-issued. The new versions of these formal documents are also recorded in the register.

Comparison of the contents of different issues of project documentation and the items published within them, are fully supported.

Published documents can be provided to customers and suppliers. They can also be captured using the Document Loader tool, after an external group has made changes. So cyclical processing of external documents is supported. When combined with the register of the issue states of project documents, this facility means that all document-orientated processes are supported. The tools therefore fully support all customer-supplier and supply chain management contexts.

Feature Summary

Feature	Benefits
Arbitrarily large and complex documents	Generate the documents that your project needs with any format, any layout, any style and of any size
Document templates defined in Word	Generated documents have the same style as all other documentation
Integrates into project workflows	Once generated, documents from Cradle can be processed in the same way as any other document
Document contents defined through UI	No complex scripting languages to learn, use existing paragraph, character and page styles
Runtime variables	Define a single template from which several different documents can be published
Controllable information ownership selection	Document approved project baselines, current work-in-progress of the latest information from either source
Automated section numbering	Create arbitrarily complex document structures automatically based on information structure within the database
Arbitrary cross reference nesting	Create tables which follow any number of levels of cross reference according to user-defined rules
Document self-referencing	Structure later sections based on the contents of earlier sections, including where the structure of these earlier sections has been generated completely automatically.
Built-in support for PVM, RTM and similar matrices	Easily construct major tables in specification documents by using built-in support for the most common traceability matrices
Embed figures and tables	Reflect the rich internal structure of Cradle database items in your generated documents
Batch mode	Automatically generate documents when users are off-line
Formal document register	Maintain a list of the issue of specific versions of formal project deliverable documents, with the means to reprint any document version on demand
Formal document correlation	Know which versions of which items are published in each issue of each document. When an item changes, know which documents need to be re-issued. Compare documents to report the differences in items and items' instances shown inside them.

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Cradle-WEBP

The **Cradle-WEBP** module publishes sections of Cradle databases as fully hyperlinked, standalone, websites that can be viewed independently of Cradle.

In general, users will access a Cradle database through a Cradle web UI or a non-web UI such as WorkBench.

There are situations where direct access is not possible, particularly if the users are remote from the database and do not have any external electronic access, or if the data is classified and cannot be sent across a public network, such as the Internet, even if the connections are secured.

In such cases, database information is normally published into one or more documents that are provided to the external users. This works well, except that documents are linear, a sequence of pages, and it is not always easy to explore their contents. This is particularly true for analysis and design models where there are many connections between the models' components, and also when following cross references between items.

The Web Publisher tool generates a static website containing some or all of the items in a database. This website contains three types of page:

- A top-level page
- Pages containing lists of each item type that has been published
- Individual pages for each item

The pages for individual items contains lists of links to related items of each type, grouped by the type of cross reference.

Diagrams are published as SVG so they can be zoomed, panned and scrolled. All diagram symbols are hyperlinked to lower-level diagrams and to the symbols' descriptions in specifications and data definitions.

So the pages for individual items are connected by hyperlinks in the same way that the database items are connected by cross references.

Users can follow these hyperlinks to explore the information in any way that is convenient to them.

By being static, the website is fully independent of Cradle. By being read-only, the websites can be distributed on CD or DVD. In effect, the website is a self-contained snapshot of the parts of the database that you have chosen to publish.

User-defined criteria specify the item types, and items of these types, to be published from the database. The form and content of the website's main page can be controlled with a user-defined template. The tables for each item type have user-defined columns and contain any attributes. The pages for items have individual user-defined templates so that the layout and attributes to be published can be controlled.

Collectively these templates are called a theme.

Several themes are provided with Web Publisher. You can create your own themes to include your company or project logos and branding.

Items in a Cradle database can contain any number of attributes of a wide variety of types, including URLs. So any item in Cradle can contain URLs that link it to other resources, either on

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the Internet, an intranet, or data in another environment.

You can include these URL attributes in your templates for the Web Publisher. By doing so, the pages published by the Web Publisher will contain these URLs so that a user browsing the published website can follow the URLs to access the related information, wherever it may be.

Websites are published into a user-defined top-level file and a directory containing all other pages. It is easy to link the generated site into a larger set of information, including any site-specific modifications to the hyperlink URLs.

Different baselines, or work-in-progress, can be published to separate websites, for comparison between approved and current activities.

Feature Summary

Feature	Benefits
Controllable website contents	Generate website with just the content required
Controllable website data ownership	Report either the baselined information, or work-in-progress, or the latest of both
Tabular item lists	All item types are published as navigable tables with controllable attributes and column widths, all table cells are hyperlinked to the corresponding item definitions
Hyperlinks	Follow cross references between project data items by selecting the corresponding hyperlinks in the published website
SVG graphics	Allows panning, scaling and zooming of diagrams
Models are fully hyperlinked	All diagram symbols are hyperlinked to their corresponding definitions, and are also hyperlinked to their child (expansion) diagrams - where appropriate
Full color and image support	All embedded pictures, images and symbol colors are reproduced in the final website
External hyperlinks	Link the generated website into web outputs from other tools, or into pages in an existing site or intranet
Automatic page controls	All generated pages automatically contain site navigation and print controls, allowing users to easily browse the published material
Controllable main HTML page and contents subdirectory	Generate multiple website components for different sections of the database and combine them into an overall project website
Customizable HTML layouts	Publish just the data required in any desired layout
Hierarchical HTML style templates	Define an overall look for the published database from corporate or project standards and reflect throughout the published websites
Pre-production and production sites	Publish either to a pre-production area, or to a production website, with automated redirection of external hyperlinks

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Cradle-7
From concept to creation...

3SL

Cradle-WEBA

The **Cradle-WEBA** module provides the means to create custom web UIs that allow users to access Cradle databases from web browsers in a manner that is appropriate to their needs and use cases.

Cradle provides WorkBench as the means to access databases, and provides many choices to create a customized environment, including start pages and the phase hierarchy. However, WorkBench is not suitable for all users:

- Users may not want to install Cradle
- Users may be remote from the Cradle system and WorkBench may not provide acceptable performance (despite server-side processing)
- Users may not allow Cradle to communicate through their firewall
- WorkBench provides more functionality than needed and, therefore, appears too complex

So there are at least three reasons why a project may wish to create web UIs:

- IT restrictions on the use of WorkBench
- Performance needs of remote users
- Provide simple UIs tailored to the needs of specific user groups

Cradle allows web UIs to create, manipulate or view database information. Each web UI is created to meet the needs of a group of users, either to offer a wide range of UI controls to provide a flexible and powerful UI so users can perform many tasks, or a simple UI that allows users to perform perhaps one or two tasks very quickly and easily.

All web UIs are zero thickness, with no client-side code. No browser add-ins or plug-ins are needed.

Any number of web UIs can be created. Each is associated with a project-specific user type. Each Cradle login account is also associated with a user type. When a user connects to the Cradle Web Server (CWS) and logs-in, the CWS serves the web UI defined for the user's user type, or a default web UI.

Therefore, the CWS can serve many, potentially very different, web UIs to its users, based on their user types.

Users login to a web UI with the same username and password used with non-web tools. Web-based users have the same access rights to items and Cradle operations as users of non-web tools such as WorkBench and utilities.

Web UIs are created from templates and building blocks provided in the **Cradle-WEBA** module. The module also includes two example web UIs:

- A web UI using all blocks to offer a powerful and flexible environment for engineers
- A basic UI providing controls over page layout, item creation, viewing and reporting

In the example web UIs, users can create, view, edit and delete items and they can manipulate and follow cross references.

Users can navigate through the database using the phase hierarchy, the master tree, or using a table-based browse mechanism.

Items edited in web UIs are locked in the same way as non-web UIs and the API, to prevent simultaneous update by other web or non-web users.

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Tables of items shown in web UIs will load into Word® and Excel® as hyperlinked documents.

Web users can create and use the same queries as non-web UI users. All query processing is server-side in the CWS to optimize the performance for each user.

Views created in WorkBench can be used in web UIs. Items can be edited in table views. Items can be shown in user-defined forms. Binary data can be modified and uploaded in a web UI. Rich text can be shown in web UIs.

Diagrams are shown in SVG. Diagrams can be zoomed and panned. Hyperlinks in each diagram symbol allow users to navigate to child diagrams and from symbols to their descriptions in data definitions and specifications.

Change histories are fully supported, together with all collaboration facilities, including discussions and alerts.

Authentication to web UIs can use LDAP and supports single-sign-on. Access to web UIs can be limited to specific proxy servers, network interfaces and remote hosts.

Cradle provides `cradle://` protocol URLs that allow direct access to items and query results by external tools.

Feature Summary

Feature	Benefits
Web UIs for RW and RO access	Provides access to the database for users for whom non-web UIs are impracticable or undesirable
Zero thickness web UIs	All web UI building blocks and all example web UIs can be deployed without any restrictions, particularly in environments where application security is vital, and do not need browser add-ons or plug-ins
Define any number of web UIs	Web UIs can be designed to meet the needs of specific user groups, either general purpose or task-specific
Two example web UIs	Two different styles of web UI are provided for you to use, or to help you build your own custom UIs
Serve multiple web UIs	The Cradle Web Server can serve a user community simultaneously requiring any number of web UIs
Consistent access controls	User authentication and authorization controls are identical to non-web UIs
Consistent user environment	The same queries, navigations, metrics and reports are available through web-based and non-web UIs
Phase hierarchy	User-defined process-orientated UI is available in web UIs wherever needed
Server-side processing	All query processing is server-side, improving performance for remote users
Generate reports	Any reports, including metrics, tables and matrices can be generated from web UIs
User-defined views	Views can be defined showing textual, numeric, image or any other attributes. They can include UI controls to sort by any column. Item can be edited through views. Views from WorkBench are available in web UIs.
Nested table support	Correlation, traceability and coverage analysis views can be shown between any types of information, and allow interaction with items at any level
User-defined forms	Any forms can be defined showing textual, numeric, image or any other data types, with facilities to download and upload binary content where needed
Diagram viewing and navigation	Model diagrams shown using SVG that allows zoom, pan and scroll, and allows navigation to symbols' child diagrams and descriptions in specifications and data definitions
Full change history support	All changes made through web UIs are included in items' change histories
Full discussion support	All project collaboration facilities are available through web UIs in the same way as non-web UIs
Item review support	Simple item review mechanism that is very easy to use for occasional Cradle users
URL login and initial actions	Provide direct access to Cradle database items by external tools
Flexible user authentication	Users can authenticate with username and passwords. LDAP can optionally be used to verify these. Single-sign-on is supported through the REMOTE_USER HTTP request header.
Flexible access control	Optionally limit web UIs by network interfaces, or to a specific proxy server, or to specific remote users
Section 508 compliant	All web UI building blocks are Section 508 compliant, and so are all example web UIs supplied with Cradle
Supports all web browsers	All web UI building blocks and example web UIs fully support all current popular web browsers, including Firefox, Chrome and Edge
cradle:// protocol URLs	Embed links to Cradle items in other tools' databases, links are authenticated when used

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Cradle-SWE

The **Cradle-SWE** module provides reverse engineering and code generation to maintain the consistency between a detailed system design and its software implementation.

There are many contexts for software engineering, each using its own methods and languages. This module is intended for groups using functional methods to build software in C, Ada® or Pascal.

Detailed software designs are represented using Structure Charts (STCs) with 3SL extensions to support hierarchical descriptions of software into systems, programs, subsystems, modules and source files, the representation of functions, and the representation of basic data types.

Software designs are described with diagrams, data definitions and module specifications that hold the pseudo code, descriptions or source code. This software design is cross referenced to architecture, design and analysis models, to the requirements and test cases, and to all other data.

The initial design can be code generated to C, Ada and Pascal type definition header files (built from the model's data definitions), and source files that contain the call hierarchy from the STCs, the call arguments and local variable declarations, and the content of the STCs' module specifications' pseudo code or detailed design material.

Once algorithmic content is added to the generated code, the resulting completed source files can be reverse engineered back into the Cradle database, to update its design diagrams, and both the data definitions and module specifications of these diagrams' symbols.

Reverse engineering merges actual source code into the design definitions and specifications, subdividing each source file into the individual routines and storing their component parts into separate frames in the module specification and data definition items in the database. Every line in each source file is stored in a frame of one of these items in the database.

The Code Generator can be run on the results of reverse engineering to reconstruct the source files, either as they were, or including any changes made in the design model. In this case, the source code is generated using call interfaces built from the (possibly modified) STCs and the routines' bodies are created from either the STC call hierarchy or the source code from the previous reverse engineer operation.

The process can start by reverse engineering legacy source code into an initial design model, recovering designs in situations where only the implementation currently exists.

As reverse engineering loads all source files into the database, the source files could be deleted, and instead configuration managed through the Cradle Configuration Management System as part of the design.

The diagrams, specifications and data definitions can contain any number of attributes, including URLs to reference the source code in a source code control system, such as Git or Subversion.

The format of all generated

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code can be tailored to match your coding standards. Data definitions can be marked to be standard data types and generated into the source code. Header files can be produced from the composition specifications inside the data definitions to create record and variant structure declarations.

The reverse engineering tool supports any compiler pragmas and conditional compilation directives. It can distinguish application code, application libraries and standard library or operating system / runtime routines, and render the design diagrams accordingly. This uses any combination of regular expressions, and Cradle-supplied or user-defined library routine lists.

Reverse engineering can process one or more source files in one run, creating a hierarchy of design diagrams to represent the code structure beyond individual source files.

Using the reverse engineering tool creates full traceability across the entire system lifecycle, from user needs to system requirements to analysis, architecture and design models, to test procedures, specifications and test cases, to the source code. Cradle's transitive cross reference view facilities allow users to directly see the user requirements and acceptance criteria associated with each source code module, and vice versa.

Feature Summary

Feature	Benefits
Integrated with design model	Provides the link between the design database and the system implementation
Code generation, reconstruction, and reverse engineering tools	Bidirectional exchange of source code with the code development system and synchronization of the detailed design with the software implementation
Customizable code reconstruction	Reorganize source files from original layouts and optionally include design database changes in the generated source code
Absorbs all source code into design database	Cradle database can manage approved software releases in formal baselines, while the code development system is used for interim work
Batch processing	High productivity by code generating or reconstructing any number of design diagrams as one operation, and by reverse engineering entire directory trees as one operation
Cross referenced software implementation	Complete traceability from stakeholder needs to source code, via analysis and/or design models, and full linkage to all test specifications, test results, and all other project data
Support for C, Ada, and Pascal	Applicability to a wide range of new and legacy projects
Customizable code generation	Conform to local coding standards
Choice of reverse engineering operations	Create design diagrams and/or load definitions and/or analyze code characteristics, or all of these
Automatically creates code design diagrams	Recognizes your code, your libraries and third party libraries so design diagrams correctly identify all routines and your application is not obscured by secondary code
Customizable reverse engineering	Optionally suppress system or library routines, control the layout of generated diagrams and options for populating the database with module and data definitions
Supports compiler pragmas and conditional compilation directives	Reverse engineer all code or only the code for a specific combination of compilation options. Uses the same syntax for conditional compilation as the compiler.

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