Metamorphosis

Adapting rapidly to change using the IDEAL improvement model

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Corporations must adapt rapidly to changing markets and adopt new technologies to remain competitive. Such adaptations are particularly important in a rapidly changing economic climate. Flexibility and a willingness to change are important qualities that must be fostered and encouraged, at all levels, if businesses are to respond effectively to shifts in product demands or to altered customer requirements. To encourage a positive environment for such change, the process for change must be carefully planned, well managed, properly justified and applied with sensitivity. ABB uses the IDEAL^{SM} 1.0 model as a framework to guide improvement processes so that effective changes are deployed efficiently.

ABB provides its business units (BUs) with innovative solutions to improve the introduction of new products, new technologies, new methodologies, and innovative processes that enhance ABB's products or methods of production. This assistance helps ABB's BUs to provide novel products and services to their customers and to enhance ABB's competitive position.

Developing new products or introducing new technologies, methods, or any kind of improvements to the BUs are exciting activities that provide many benefits. However, such activities can be disruptive and trigger resistance to change at different levels within the organization. It is important, then, to have a systematic approach to manage a change or improvement program. All of ABB's research centers are concerned with bringing change in one way or another to ABB. Improvement programs directly affect BUs and typically involve collaboration to introduce new technologies, develop new products, use new materials, improve production methods, enhance the design of existing products, optimize product development methods and promote many other initiatives. ABB Corporate Research effectively uses an organizational improvement model to collaboratively establish, execute, and accelerate improvement programs in BUs. This model, called IDEAL℠ 1.0, was first developed by the Carnegie Mellon® Software Engineering Institute (SEI) and its original aim was to improve software development processes. Nevertheless, ABB has successfully employed IDEAL to guide other activities that will also create improvements within the company's BUs.

Phases of the IDEAL model

The IDEAL 1.0 model is defined by five main phases [1] 1:
1) Initiate
2) Diagnose
3) Establish
4) Act
5) Leverage

Each of the five phases of IDEAL is described below.

Initiate phase

In this phase, a foundation is laid for a series of successful improvement efforts. The phase starts when a stimulus for improvement is identified and understood by the relevant stakeholders. At the end of this phase, a strategic improvement plan (SIP) is developed that defines the time horizon and overall goals of the improvement activity. A typical time horizon is equivalent to the length of at least two improvement cycles. The primary tasks associated with the Initiate phase are summarized in the Factbox.

Research centers at ABB have developed several tools and methodologies that are used during the Initiate phase of IDEAL. A business decision-making model is used to identify the business benefits of an improvement project. An assessment is made of a BU's readiness for change. The assessment identifies areas of possible resistance to change, and provides a plan to prepare the way so that the organization can embrace the proposed improvement. An SIP is created, which is designed to ensure that each improvement activity within the BU is supported with appropriate resources.

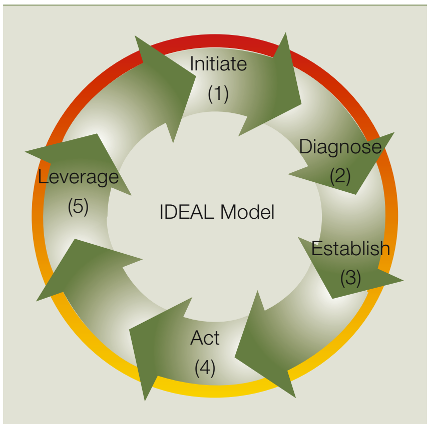
> ABB employs the IDEAL℠ model to collaboratively establish, execute and accelerate improvement programs.

Diagnose phase

This phase in the improvement program establishes an understanding of the current technologies, processes and organizational interactions, which are documented to create a baseline for the improvement activity. This information supports the improvement planning and prioritization process, and acts as an indicator to help track and verify the impact of the program's activities. The main tasks of this phase are to:
1) Determine how many and what types of diagnostics are required to define the organization's baseline with respect to the planned improvement activity.
2) Plan for the activities, resources, and skills required for the diagnostic activities.
3) Conduct the diagnostic activity to identify the strengths and weaknesses of the BU with respect to the improvement goals.
4) Communicate and document the findings to the organization.

Several internal diagnostic tools have been developed by the ABB research centers for evaluating product architectures[1], technologies, and processes, all based on sound engineering

1 IDEAL improvement cycle



Factbox Tasks associated with the Initiate phase

1) Define the approach to run the improvement program.
2) Identify the business needs and drivers for improvement from the management view point.
3) Assess the organizational readiness for the improvement program and use this information to define management strategies.
4) Write an SIP, and obtain both approval and commitment of resources from senior management.
5) Create awareness, set expectations, and build support for the forthcoming improvement program within the BU.
6) Establish the infrastructure to provide visibility and support for the improvement program.
7) Define measurable goals for the improvement program.
8) Launch the improvement program.

Footnote

[1] Product architecture encompasses the structure that integrates the components and the subsystems of a product into a coherent mechanism to perform an intended function and also considers its methods of use, methods of maintenance, and its production.

Sustainable results

principles and proven methodologies developed in industry and academia. To evaluate product and system architectures, ABB has tailored a software architecture approach using the attribute-driven design (ADD) and Architecture Tradeoff Analysis Method® (ATAM®) developed at the SEI [2,3,4,6]. To evaluate technologies, the company has developed an Attribute Hierarchy-based Evaluation of Architectural Designs (AHEAD) methodology, based upon the Analytic Hierarchy Process (AHP) approach [7]. For diagnosing product development processes, ABB has developed an internal appraisal method, based on the Standard CMMI® Appraisal Method for Process Improvement® (SCAMPI®) [5].

Establish phase

This phase establishes the foundation for the actions of a specific improvement cycle. The course of action taken is determined by the results of the diagnostic activity. To implement this decision, a plan to make the appropriate changes (introduce a new technology, develop a new product, make improvements in processes or change the architecture of a product) is developed, which draws on the vision established during the Initiate phase. The primary tasks of the Establish phase are to:

1) Review the BU's vision, business plan, key business issues, and motivations identified in the Initiate phase, and realign the improvement program objectives if necessary.
2) Update the SIP as necessary.
3) Based on the final findings identified during the Diagnose phase and the BU's business objectives, choose and prioritize activities, and develop the tactical improvement plan (TIP). This plan guides the improvement activity during the cycle.
4) Build consensus, review, obtain senior management approval for the TIP, and commit the resources to action.
5) Establish the technical working groups (TWGs) who will be responsible for implementing the TIP.

Act phase

In this phase, the TIP is put into action. The improvements are developed, piloted, and deployed across the BU by the TWGs. The primary tasks in this phase are to:

1) Execute the TIP as a project.
2) Develop and pilot potential solutions as identified in the TIP.
3) Collect and analyze pilot results and derive lessons learned in the improvement project.
4) Develop roll-out strategies based on pilot results and lessons learned.
5) Roll out the selected solutions, providing long-term support to ensure smooth transition.

During the Act phase, good project management practices are used to ensure that the improvement projects remain on schedule, on budget, and deliver the expected results.

Leverage phase

The objectives of this phase are to analyze how the improvement cycle was carried out, to assemble the lessons learned, and to incorporate these lessons learned into the SIP that will be used in the next improvement cycle. The Leverage phase feeds into the Initiate phase for the second improvement cycle. The primary activities of the Leverage phase are to:

1) Gather lessons learned during the improvement cycle.
2) Analyze lessons learned and decide how to utilize them in future cycles.

Once the Leverage phase has been completed, a new improvement cycle begins, starting again with another Initiate phase that is consistent with the SIP.

The IDEAL model ensures that the introductions of new technologies, products, or improvements in ABB are based on strong business drivers.

To ensure the improvement strategy is implemented effectively, an agent for change is assigned authority and responsibility for organizing, planning, staffing, monitoring and directing the improvement program to ensure that the activities of the entire IDEAL cycle are performed effectively.

Use of IDEAL at ABB

The IDEAL model has been used in many of ABB's BUs. The following examples illustrate two particular cases. The first and more detailed example describes a software process improvement project at a product development BU. The second relates to a project focused on re-architecting[2)] a software product in another BU.

Footnotes

2) Rework on software is the potentially avoidable work that is required to correct problems or tune an application.

3) Goal-question-metric (GQM) is a goal-driven method that uses metrics to improve the software development process (and its resulting software products) while maintaining alignment with business organization and technical goals.

Software process improvement
At the inception of this project, senior managers identified several organizational business goals. One of the most significant was to reduce the cost of rework[2] by a defined percentage after software integration testing. ABB Corporate Research partnered with the BU to help to achieve this goal, applying the IDEAL model as a fundamental part of the improvement activity.

Initiate
During the initiation phase, the BU senior management defined specific reductions in software rework targets as the business goal. They identified a minimum time horizon of two years in which continuous software process improvement activity would be addressed, not only to achieve the immediate business goal, but also to address future goals related to software process improvement. A decision was also made to seek support from Corporate Research for this activity. To this end, a team responsible for the process improvement project was created, including an agent for change from the BU, together with two software engineering experts from Corporate Research.

To guide the software development improvement process, CMMI® v1.2, developed by the SEI, was used. The metric employed to measure the success of the improvement program was to monitor the time required to rework software, ie, the time taken to remove software product defects identified after integration testing.
An organizational change-readiness assessment was conducted that considered a variety of factors within four categories: 1) organizational acceptance to change; 2) commitment to the sponsor; 3) willingness of the change agent to drive change forward; and 4) the organizational expertise available for the implementation of change. The results of this assessment are summarized in 2.

> The IDEAL model helps foster a continuous improvement culture in the organization.

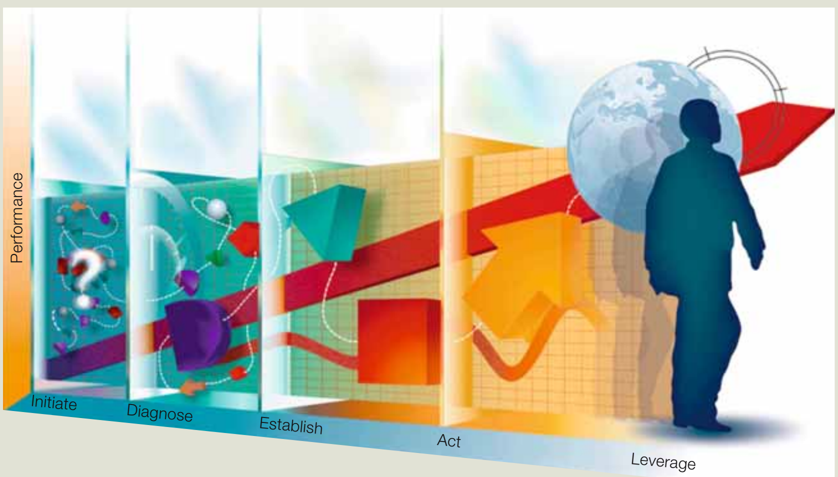
A thorough analysis of the results showed that the change agent required technical training in CMMI and change management, and needed to increase his time commitment to the improvement project. The sponsor needed to "walk the talk," demonstrating his commitment to the improvement project to the rest of the organization. Finally, the organization needed technical training to better understand the good development practices that underpin the CMMI.

Diagnose
To define a process improvement baseline, a diagnosis of the BU's development process was conducted using the CMMI model and ABB's internal CMMI appraisal method. This appraisal resulted in the identification of strengths and potential areas for improvement in the BU's processes, which would reduce rework after integration testing.

> ABB's drive towards continuous improvement highlights its commitment to enhance products and services.

Establish
Using the goal question metric (GQM)[3] analysis, priority areas that would support the achievement of the business goal were identified. One area selected for improvement was Requirements Management (REQM). Although the BU had a strong Requirements Engineering (RE) process[4], it was performed manually. Natural changes in requirements during the development life cycle were not captured fast enough, resulting in large amounts of software rework after system testing. With this information, a TIP was created to provide automation support for the RE process and a TWG was launched.

Act
During this phase, the TIP generated to improve and automate the RE process at the BU was successfully carried out. The project focused on using



2 Organizational change chart for the software process improvement project

Footnote
[4] The Requirements Engineering process described in this article is the combination of both Requirements Development and Requirements Management processes. Requirements Development refers to eliciting, producing, and analyzing all the requirements associated with a development project, including both technical and non-technical requirements. Requirements Management refers to the management of all requirements and change requests received or generated by the development project.

Sustainable results

the basic elements of the existing process and enhancing it so that it could be automated. Once the new RE process was completed, it was piloted and then rolled out to the organization.

Leverage

At the end of the first cycle of the continuous software development process improvement activity, the quality group in the development organization gathered measurements and reported that, due to the improvement to the RE process, a 30 percent reduction in the software rework effort was achieved. During the leverage phase, the improvement team identified aspects of the improvement project that worked well and aspects that did not work as expected. An area that was deemed very important was enhancing the communication between the change agent and the sponsor. Additionally, senior management in the BU decided to continue the project as planned for another one-year cycle to address additional areas of potential improvement.

Re-architecting a software product

In a second example, senior management at an ABB product development BU identified an important business goal to increase their market penetration by a defined percentage. Several options were considered by the BU to meet this business goal. The BU selected the option of re-architecting their main product, and began by investigating the use of a different software technology for its development.

> A willingness to adapt rapidly to changing markets and to adopt new technologies is essential in a highly competitive business environment.

Initiate

Based on the management commitment to redesign the product, a high-level agreement and plan were jointly developed by the BU and research centers, committing resources to complete the project within a certain time horizon. A set of metrics was identified that emphasized the importance of maintenance costs and the value of market penetration. Furthermore, an assessment of the readiness of the BU to redesign their main product using a new technology was conducted. Re-architecting a software product using a different software technology highlighted the possibility that software developers might need further training.

Diagnose

After defining the required software quality attributes that were most important for the product, a set of architectural scenarios was generated and used to evaluate the current product design, using ABB's internal ADD-based method for software architecture evaluation.

Establish

A detailed plan was created to evaluate and select new software designs.

Act

The actual evaluation of software design options was performed using the AHP-based AHEAD [7] method for technology evaluation, and a prototype of the product incorporating the selected design was developed.

Leverage

Lessons learned were collected and documented.

The primary activities carried out while using the IDEAL model in both software process improvement and product re-architecting are summarized in 3.

> The leveraging of lessons learned helps to ensure that the improvement activities have a positive impact on the products and services ABB offers to its customers.

Benefits of using the IDEAL model

Several benefits have been observed in using the IDEAL 1.0 model. These benefits are summarized below.

3 A summary of the primary activities carried out while using the IDEAL model in both software process improvement and product re-architecting

IDEAL℠ 1.0 phase	Software process improvement	New product design
Initiate	1) Reduced cost of integration testing by a defined percentage 2) Ran a continuous software process improvement project for at least two years 3) Created a responsible team for software process improvement 4) Used CMMI as improvement model 5) Selected rework time as metric to be monitored 6) Made a readiness assessment that indicated the need to increase sponsor and change agent commitment as well as organizational training 7) Created SIP for process improvement	1) Increased market penetration by a defined percentage 2) Redesigned current main product and investigated the use of new technologies 3) Used ADD method to redesign product 4) Selected metrics of increased percent of market penetration and reduced maintenance cost 5) Made a readiness assessment that indicated the need to provide organizational training in new technology 6) Created SIP for redesigning product
Diagnose	1) Internal CMMI appraisal was conducted by Corporate Research to create a baseline of process areas at the BU	1) Developed design scenarios based on product quality attributes 2) Used ATAM (from the SEI) to diagnose current product design
Establish	1) Used GQM approach to prioritize improvement activities 2) Developed prioritized TIP for process improvement 3) TWG created and assigned	1) Created plan to redesign product and evaluated suitable software technologies for implementation 2) Developed TIP for redesign project
Act	1) RE process enhanced and automated 2) New process tested in pilot development project	1) Built new product designs and prototypes using candidate technologies 2) Used AHP to evaluate prototypes and design options, and selected a technology
Leverage	1) Measured percentage reduction in integration testing costs (result: even higher than expected) 2) Documented lessons learned	1) Documented lessons learned

First, the IDEAL model ensures that the introductions of new technologies, products, or improvements in ABB are based on strong business drivers, which in turn reflect market demands, responding to customers' needs, and the desire to continually improve our competitive position. Second, the IDEAL model systematically establishes a solid framework for change at the affected BUs, building strong commitment to the desired improvement or change. This, in turn, translates into commitment to our ABB customers to support the new technology or product and to ensure that proper migration paths are developed. Third, the IDEAL model is a great tool for planning the necessary resources and effort required to implement the improvement or change, which in turn increases customer confidence that ABB is a committed partner providing the product or service improvements they need. Fourth, the IDEAL model fosters a continuous improvement culture in the organization. Continuous improvement means that we are committed to constantly search for opportunities to enhance the products and services we provide to our customers and to listen and act on our customers' needs. Finally, the Leverage phase of the IDEAL model provides a useful mechanism to collect lessons learned on each improvement activity, which can be stored, indexed, and accessed when a new improvement cycle begins. This leveraging of lessons learned helps to ensure that the improvement activities have a positive impact on the products and services ABB offers to its customers.

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