



DMAIC Done the New-Age Way

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A new age begins whenever new methods and resources make it possible to do something as never before. History is full of examples. Data science has begun a new age for continuous improvement as its analytics are put into play through project processes such as DMAIC (define, measure, analyze, improve and control).

The insight analytic methods of data science give us the power ask and answer [five types of questions](#) (relationship, difference, time series, duration and apparency). Answering them is new-age because they are essential to improving a process, but historically only weakly broached.

The purpose of this article is to expand on the emphasis of new-age questioning and modeling for insight at each stage of DMAIC. It will concurrently identify the new-age continuous improvement leader's responsibilities to train the team members to be new-age operatives, subject matter experts and Lean Six Sigma belts.

Figure 1 maps the emphasis on questioning and modeling, and training as activity at each stage. The upper track summarizes how the new-age tasks of DMAIC arise in each traditional stage. The lower track summarizes how the team members will be trained to be new-age as the DMAIC stages unfold.

Design	Measure	Analyze	Improve	Control
New-age work woven into the traditonal stages				
<ul style="list-style-type: none"> ▪ Reshape project plan upon data science. ▪ Set new-age, high level measures as north star to project. 	<ul style="list-style-type: none"> ▪ Build, explore data without limits. ▪ Recast visually, descriptively. ▪ Quick-model data in context. 	<ul style="list-style-type: none"> ▪ Frame new-age questions to ask of processes. ▪ Team iterative model-build, exploration, decisions. 	<ul style="list-style-type: none"> ▪ Structure models to confirm 6-sigma capability. ▪ Simulate variables to model as can-be, to-be. 	<ul style="list-style-type: none"> ▪ Enact new-age analytic measures. ▪ Train operatives to generate and interpret measures.
Training while enacting the new-age				
<ul style="list-style-type: none"> ▪ Five types of questions by model types. ▪ Type-specific new-age measures from models. 	<ul style="list-style-type: none"> ▪ Extract, cleanse, join data. ▪ Form visual and descriptive statistics. ▪ “How to only” set up, run, interpret models. 	<ul style="list-style-type: none"> ▪ “Full” principles to build, diagnose, interpret models. ▪ Deep model-enabled questions. 	<ul style="list-style-type: none"> ▪ “Full” principles of simulation, prediction. ▪ Simulate variables to prediction. ▪ Set up, run prediction models. 	<ul style="list-style-type: none"> ▪ Team members to teach others in the data science learned during project: skill pyramiding.

Figure 1: Methods and learning data science as woven into project stages.

Stage 1: Define

The five types of new-age questions that data science makes possible will dramatically reshape the project plan. Planners will write the plan in accordance with the vastly advanced breadth and depth to which a team can characterize and explore exactly what constitutes performance to customers and stakeholders.

It follows that the plan will also specify the high-level, new-age measures which will become available from models. This is in contrast to conventional intelligence-type measures and KPIs which are essentially raw information without the analytic payload of those extracted from models.

At this stage, the continuous improvement leader’s role includes training the team members to know the five types of questions. Geek-type training will be limited to explaining which outputs of the answering models can be extracted as analytic-based measures.

Stage 2: Measure

This is the stage to gather data, construct flowcharts and diagrams of the as-is, and conduct the first explorations and measurements of the subject and system of operational processes. Top tier software such as R (free at <https://www.r-project.org>) and SAS (commercial product) allow the stage to move fast and hit hard until the team is satisfied with what it knows.

The bigger point is the insight and discovery that is possible from troves of process data. The team will search for nuances and compliance across the as-is. The data will be concurrently

recast in the many types and visualizations of descriptive statistics. At the same time, the data will be dropped into the question-related models to gain initial contextual insight that is beyond what is visible with only descriptive statistics.

At this stage, the new-age continuous improvement leader's responsibilities include training the team to find, extract and join data from across sources and systems, cast the data as descriptive statistics, roll the data into models, and interpret the descriptive statistics and models. Also at this stage, the team members will begin to gain working skills with top-tier statistical software such as R or equivalent software such as SAS and SAS Enterprise Miner.

Stage 3: Analyze

Imagine placed in front of the team are the traditional flowcharts and diagrams of the analyze stage. Additionally, imagine that newly placed in front of the team are the considerable findings of the new-age exploration and discovery from the previous stage.

Imagine the team forming very specific questions for elements along the process, specifying the answering models and participating in their interpretation as they are built iteratively during team sessions. Just as importantly, imagine the team using the models to identify, explore and quantify the hidden interplay of the subject process and the entire system of operational processes.

At this stage, the new-age continuous improvement leader's role is to teach the technical principles and diagnostics of the team's models as compared to the more "here is how" training of the previous stage. As always, skills transfer will take place as part and parcel to team sessions. Furthermore, the models of the phase will become a body of "go-bys" that the team members will use elsewhere.

Stage 4: Improve

At this stage, the team has acquired a new-age knowledge and understanding of the subject process and surrounding system of processes. Prior to the age of data science, a great deal of what the team will have come to know would not have been knowable.

From what is known going into this stage, a team typically charts and sets measures for the can-be and to-be. Thence, the team will confirm that the designed operational process is capable of living up to its promise.

The models used to question in the previous stage are now redirected to testing if the charted can-be and to-be processes will be capable. Testing will also confirm that expected performance will be truly, rather than seemingly, within six sigma variance. Just as importantly, the enterprise will be able to make adjustments and gain the assurances prior to conducting disruptive and potentially risky pilot projects.

The new-age continuous improvement leader may bring center-of-excellence level data engineers and scientists into the team at this stage. This will be the case whenever the to-be process requires specialized programming, permanent and one-off applications, and exotic skills.

At this stage, the continuous improvement leader's role includes training the team members to simulate variables and work with their models in a predictive way. The team's members will have progressed to full working competency of questioning and modeling—they have become new-age.

Stage 5: Control

Most processes are not manufacturing processes in which classic statistical process control and process capability indices play. However, the previous stage will have identified measures in the models that are sensitive to achieved and continued success, as well as, any drift away from success. As permanent solutions are built and started up along the process, the analytic-type measures will become the new standard.

The new-age continuous improvement leader's training responsibilities during and after this final stage reflect that the most impactful of all improvements is the improvement of an enterprise's ability to frame, ask and answer questions. The enterprise will organically accumulate the scarcest new age resource of all; continuous improvement leaders, subject matter experts and operatives who utilize data science in their work.

During the control stage, there is the responsibility to mentor team members as they train others to conduct the solution. After the control stage, there is the continuing responsibility to mentor team members as they engage with other projects and peers.

Sources for self-directed learning: *Discovering Statistics Using R*, Field and Miles, 2012 | *Multilevel Modeling Using R*, Holmes, 2014 | *Machine Learning with R*, Lantz, 2015 | *ggplot2, Elegant Graphics for Data Analysis*, Wickham, 2016 | *Introductory Time Series with R*, Cowpertwait and Metcalfe, 2009 | and *Event History Analytics with R*, Bostrom, 2012 | Package “tsoutliers,” Javier López-de-Lacalle, 2017.

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