Facility Management Triage for Quick & Credible Repair/Replace Funding Decisions

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Abstract

Facility managers need uncomplicated decision support tools to help them quickly and credibly allocate limited repair and replacement dollars with maximum utility. This paper describes one such tool, *Facilities Management Triage,* which combines the concept of *medical triage* with two facility performance metrics, Mission Dependency Index (MDI) and Condition Index (CI). The paper also gives an example of how a facility manager can use *FM-Triage* for making better decisions.

Key Words

Mission dependency, MDI, facility condition, CI, Operations Risk Management, Utility

Introduction

Triage is a French word meaning "sorting[3]." It commonly describes a process used by emergency medical personnel to ration limited medical resources when the number of injured needing care exceeds the resources available so as to treat the greatest number of patients possible. As a result of *medical triage*, some injuries receive immediate care, some injuries are treated later, and some injuries receive no care at all because the injured person is unlikely to survive. This process clearly has ethical implications as treatment is intentionally withheld from people who have little chance of survival so that others with a better chance are more likely to survive.

The idea of *medical triage* can be adapted to help facility managers apportion limited financial resources when the number of building components needing repair or replacement exceeds the resources available so as to yield the optimum utility. The process can also be used to screen-out projects that should be deferred if they have little or no relevance to an organization's mission.

Facilities Management Triage (FM-Triage) identifies and ranks projects that should be funded before others, as well as projects that should receive little or no funding (abandonment). This process also has ethical implications since unstudied abandonment would be contrary to the principles of stewardship.

Two key metrics used as the basis for a credible *FM-Triage* are Mission Dependency Index (MDI) and Condition Index (CI).

Mission Dependency Index (MDI)

The Naval Facilities Engineering Command (NAVFAC), the United States Coast Guard (USCG), Office of Civil Engineering and the National Aeronautical and Space Administration (NASA) have partnered in the deployment of a risk-based metric that links facilities to a pre-established, self-imposed objective or goal, referred to as mission. This metric is called Mission Dependency Index or MDI.

The MDI supports and is consistent with all Federal Facility Asset Management principles and has been recognized and endorsed by the General Services Administration[4], the National Academy of Sciences' National Research Council, the Federal Facilities Council[5] and the Association of Higher Education Facility Officers (APPA)[6].

The MDI uses Operational Risk Management (ORM)[7] techniques of probability and severity and applies them to facilities in terms of interruptability, relocatability and replaceability. MDI also takes into

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[3] Definition found at http://en.wikipedia.org/wiki/Triage
[4] http://www.fmlink.com/ProfResources/BestPractices/
[5] http://darwin.nap.edu/books/0309089190/html/89.html
[6] www.appa.org/files/pressreleases/070906_execsummary_buildingsais.pdf
[7] OPNAVINST 3500.39B, Operational Risk Management (ORM)

account mission "intra" dependencies (those that reside within an organization) and mission "inter" dependencies (those that reside between organizations). It does this through a structured interview process that captures the experience, judgment, intuition and situational awareness of leaders having authority over operational and facility decisions. The product of the interviews is a quantitative score normalized over a scale from zero to one hundred, with higher scores representing higher mission dependencies or mission critical facilities. The MDI is color coded and described over a natural distribution to better support visual decision-making. See Figure 1.

MDI Score	Operational Risk	Color Scheme
100 -85	Critical	Red
84-70	Significant	Orange
69-55	Relevant	Yellow
54-40	Moderate	Green
39-0	Low	Blue

Figure 1 - MDI Score, Terms and Colors

MDI can be used to identify real property assets that have low mission dependencies and therefore do not serve an organization's best interest and may need to be divested. Additionally, MDI is valuable for prioritizing the scheduling of facility assessments. In this area, facilities with high MDI scores require more frequent and, perhaps, more detailed inspections than facilities with low MDI scores.

The MDI's true power is its simplicity and ease of use. It is risk-based and, due to the structured interview process, is consistent, repeatable, auditable and less subjective. MDI scores simply communicate a critical and heretofore missing detail in infrastructure-related decision-making: linking facilities to mission.

Condition Index (CI)

The U.S. Army Engineering Research and Development Center (ERDC-CERL) developed CI as a key element of the BUILDER® process for facility assessment and capital planning[8]. The next-generation process is already being employed by two Federal agencies and others who want to reduce inspection and repair costs; improve credibility of condition assessments and repair budgets; enable better funding allocation and project selection; and allow meaningful tracking of spending impact.

CI emerged from the same research that produced the current ASTM standard for determining pavement condition (PCI)[9] and the BUILDER® process was rated "preferable choice" among 18 alternatives by a peer-reviewed ASCE paper[10]." The process delivers, at a fraction of the cost of traditional methods, data that Federal agencies need to meet specific requirements of the Federal Real Property Council's Guidance for Improved Asset Management.

As shown in figure 2, CI is a condition measure on a 0-100 scale (100 = distress free). A BUILDER® Life-Cycle Model computes a CI for each *building component section*[11] and keeps each CI constantly updated in real time with automatic science-based deterioration projections supplemented with fresh survey data. Survey data come from selectively-scheduled, standardized visual surveys that objectively collect risk-based data (distress types, severities, and densities) of *building component sections*. The Model also automatically re-calibrates the accuracy of its own CI projections based on latest survey data.

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[8] BUILDER® is a set of patented business processes that could be performed manually, but there is a software element pulling it all together. The newest version of BUILDER® software is Web based and includes patented capability to support both condition and functional assessments and integrate all data into performance and risk-based strategic asset management

[9] ASTM D6433-03 Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys and ASTM D5340-04e1 Standard Test Method for Airport Pavement Condition Index Surveys

[10] Ottoman, Nixon, Lofgren, ASCE, "Journal of management in engineering," July/August 1999

[11] Building component-sections are the "management units" upon which work decisions are made. Examples: a group of four 50 lb/hr central humidifiers, same model and age. A component section's condition establishes work item scope and cost for that section.

A patented "Knowledge-Based Condition Survey and Inspection (KBCSI)" model creates optimized survey schedules using updated *component section* CI data and risk tolerance triggers set by the facility manager. The KBCSI process greatly reduces inspection costs by virtually eliminating the "over-inspection" inherent in expensive, traditional condition inspections, while avoiding "under-inspection," which often leads to missed savings opportunities and hidden penalty costs.

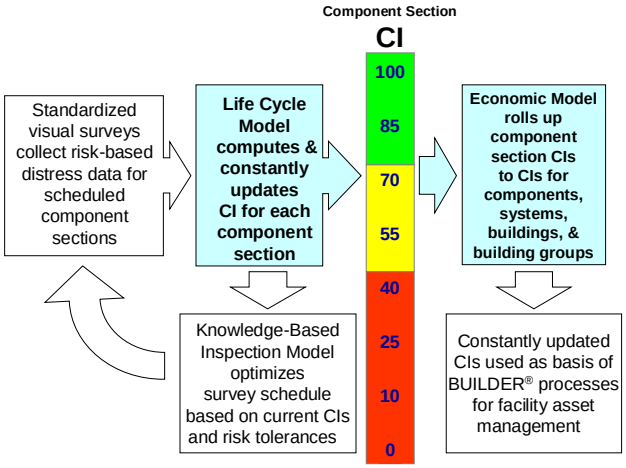

Figure 2 – Derivation and Constant Updating of Condition Index (CI)

Again referring to Figure 2, an economic model automatically rolls up *component section* CIs into condition indices for parent components, systems, the entire building, and higher building groups. The model keeps all rolled-up indices current as updates occur to component section CIs.

Constantly updated, real time *CIs* serve many purposes in the BUILDER® process. For example, CIs can be historically tracked and predicted, rates of deterioration can be computed, and remaining service life can be estimated.

The BUILDER® process uses CI to trigger the optimum, long range scheduling of repairs and replacements according to risk tolerances set by management. That is, management can limit penalty costs that accrue from work deferral by triggering the scheduling of work on any component section, system, or building when the CI for that item drops below a pre-determined value and/or when the CI for that item portends a remaining service life below a chosen, pre-set value. Management can also pre-set limits on the ratio of estimated repair cost to replacement cost so that when work is triggered for scheduling, it will be appropriately identified as a repair or replacement based on economic considerations.

Management triggers employed in the BUILDER® process need not be the same for all buildings, systems or component-sections and can combine CI with MDI so that the most important or mission-critical inventory will be inspected and maintained to a higher level than the least important inventory. Like MDI, the CI metric is risk-based and, due to its standardized inspection process, is consistent, repeatable, auditable and less subjective.

"This methodology is fundamental different and vastly superior to a facility condition index (FCI), which is simply calculated as the sum of maintenance project costs divided by the present replacement value of the system, building or portfolio being evaluated. The Achilles heal to the FCI is in the definitions used for the numerator and denominator. Where CI uses very explicit, auditable definitions, FCI definitions are known to vary widely or are inconsistently used across the industry or even at individual locations. This introduces great uncertainty when using FCI in support of funding allocation and prioritization[12]." For those who want it, BUILDER® also reports Facility Condition Index (FCI), and makes FCI available at a greatly reduced inspection cost compared to traditional methods.

[12] Commander James J. Dempsey PE, USCG. "Facilities Asset management Doctrine – A Strategy for Making Better Decisions at Lower Risk and costs," National Academies, 2006

Facility Management Triage

"Most decisions involve choices between options involving a collection of attributes that are incommensurate."[13] So it is with most decisions for allocating limited repair and replacement dollars amongst competing projects: the projects often defy objective comparison because they appear to lack common measures to compare.

Now MDI and CI can serve as the credible, common attributes needed for objective project comparison and the idea of *medical triage* can provide a frame work for applying those common measures to quickly and credibly identify the projects that yield maximum utility, as well as those that should be deferred. *FM-Triage* is a utility-based decision support tool that combines the attributes of MDI (relative mission value) and CI (condition) in the following model:

$$T = 100 - \{ [|CI_{bp} - CI_c| \times (MDI/100)] + (100 - MDI)\}$$

where:

T = Triage Score (highest number has the highest utility)

CI_{bp} = Condition Index at Best Point to perform repair (a standard set by management)

CI_c = Current Condition Index of component section/component/system/building ($1 < CI < 100$)

MDI = Mission Dependency Index of building ($1 < MDI < 100$)

From this model, a table can be constructed, fixing the value of CI_{bp} to the value that management chooses for analyzing the mix of projects under consideration. The resulting table[14] (Figure 3) can be used to quickly "triage" facility repair and replacement projects based upon the MDIs and CIs pertaining to the projects. The credibility of the results is excellent because it derives from the credibility of the underlying metrics: MDI and CI.

MDI	1	10	20	30	40	50	60	70	80	90	100
100	31	40	50	60	70	80	90	100	90	80	70
90	28	36	45	54	63	72	81	90	81	72	63
80	25	32	40	48	56	64	72	80	72	64	56
70	22	28	35	42	49	56	63	70	63	56	49
60	19	24	30	36	42	48	54	60	54	48	42
50	16	20	25	30	35	40	45	50	45	40	35
40	12	16	20	24	28	32	36	40	36	32	28
30	9	12	15	18	21	24	27	30	27	24	21
20	6	8	10	12	14	16	18	20	18	16	14
10	3	4	5	6	7	8	9	10	9	8	7
1	0	0	1	1	1	1	1	1	1	1	1

CI

High Utility Projects

Medium Utility Projects

Low Utility Projects

Figure 3 – FM-Triage Scores

[13] Morgan M.G. and Henrion M. (1990), "Uncertainty, A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis", Cambridge University Press, Cambridge UK

[14] The value of C_{bp} was set to 70 for this example.

Example:

A campus has eight candidate projects with an estimated total cost of $1,200,000. Due to budget constraints, only $900,000 will be available for award. Figure 4 shows the relevant MDI and CI for each project, gives the associated *FM-Triage* Scores from Figure 3, and ranks the projects according to *FM-Triage* scores. Under this scenario, projects 3, 5, 7, 8, are quickly identified as "high utility" candidates for funding with available dollars. Additionally, project 2 is identified as the highest ranking of the "medium utility" candidates and also fundable within budget constraints. The triage score for the Garage project identifies it as a deferrable "low utility" project and the low MDI/poor condition suggest the facility may be a good candidate for divesture.

Project No.	Facility Name	Project Description	MDI	CI	Triage Score	Ranking	Est. Cost (K)	CUM Cost (K)
3	Information Technology	Repair HVAC System	100	70	100	1	$ 165	$ 165
8	Library	Install New 400 Amp Panel & Wiring	100	60	90	2	$ 180	$ 345
7	Conference Center	Install New Interior Lighting Fixtures	85	70	85	3	$ 145	$ 490
5	Headquarters	Interior Painting and Carpeting	80	70	80	4	$ 100	$ 590
2	Clinic	Replace Existing Doors & Windows	60	70	60	5	$ 260	$ 850
1	Cafeteria/Galley	Repair Loading Dock	70	50	56	6	$ 73	$ 923
4	Warehouse	Repair Roof	70	40	49	7	$ 152	$ 1,075
6	Garage	Replace Hydraulic Hoist	20	30	12	8	$ 125	$ 1,200

Figure 4 - FM-Triage Score Card

Conclusion

FM-Triage provides a quick and credible solution to a complex problem by ranking repair and replacement projects to produce supportable funding decisions designed to achieve optimum utility with limited financial resources. The process also can be used to screen-out projects that should be deferred if they have little or no relevance to an organization's mission.

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