

2-27-2014

Analytical System for Planning of Infrastructure Rehabilitation (ASPIRE)

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DOI: <http://dx.doi.org/10.5703/1288284315526>

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Recommended Citation

Purdue ECT Team. (2014). Analytical Systems for Planning of Infrastructure Rehabilitation (ASPIRE). ECT Fact Sheet IN06007. West Lafayette, Indiana: Emerging Construction Technologies, Division of Construction Engineering and Management, Purdue University. <http://dx.doi.org/10.5703/1288284315526>

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ANALYTICAL SYSTEM FOR PLANNING OF INFRASTRUCTURE REHABILITATION (ASPIRE)

THE NEED

Infrastructure systems are a part of the nation's economy through expenditures, and are necessary to accommodate economic expansion and productivity. Therefore, these systems must maintain serviceability – useful conditions of the facilities in order to safely serve users, communities, and nations - during their life-cycle. However, all infrastructure facilities deteriorate over time due to the variability inherent in the repetitive load conditions, the operating environment, the characteristics of the materials, the weather, etc. According to the Report Card in 2009 by the American Society of Civil Engineers (ASCE), the average condition of all types of infrastructure across the U.S. is poorly maintained, and the average deterioration grade is D (poor status). The main reasons are delayed maintenance and chronic underfunding.

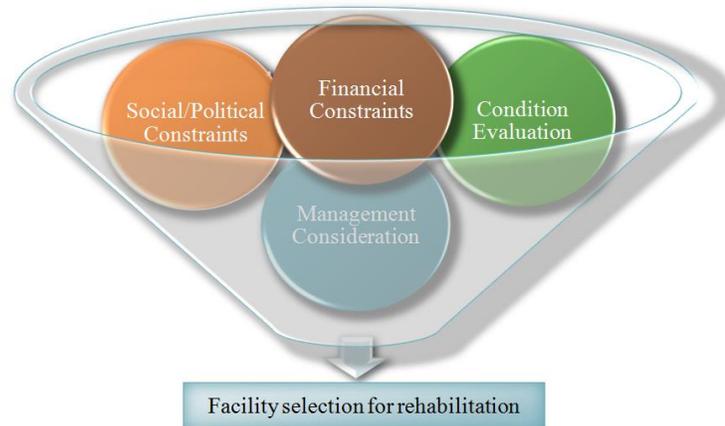


FIGURE 1 Systematic Procedure Required For Decision Making

Several organizations have in-house procedures for facility rehabilitation planning, but they lack in either one or more important considerations such as 1) systematic consideration of all the important criteria influencing rehabilitation planning, 2) group input for decision making, and 3) optimization of rehabilitation with respect to capital budget, available additional funding, partial rehabilitation Social/political consideration, and management constraints. Thus, it is important for every governing agency to plan effectively for rehabilitation of existing facilities within the constraints of the capital program, including social, political, financial, and management constraints. A systematic procedure is required for selecting facilities for rehabilitation within the prevailing constraints.



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THE TECHNOLOGY

The ASPIRE assists public and private agencies to efficiently prepare a rehabilitation plan for all types of infrastructure. It is a web-based and user-friendly decision support system designed to optimize the number of facilities that can be accommodated within a given capital program. ASPIRE considers structural rehabilitation requirements, social/political considerations, cost and funding requirements, and management constraints. The ASPIRE needs one supervisor and four inputs from four different sources, a Project Manager, 3 to 6 professionals known as Group Members (GMs), a Field Engineer (FE), and a Cost Estimator (ES) to operate the entire system. Their responsibilities are described in five interdependent levels for final selection of rehabilitation projects.

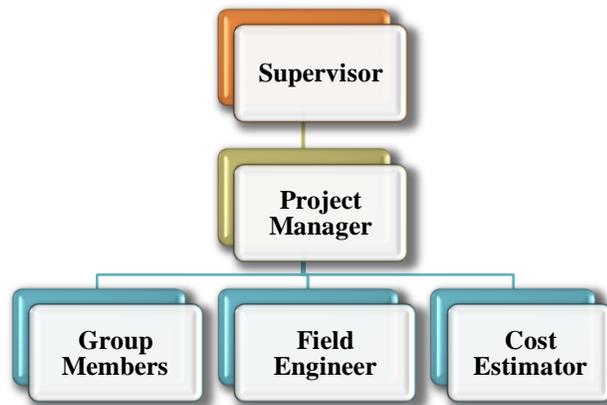


FIGURE 2 Participants in ASPIRE Hierarchy

Level-1: Technical and Social/Political Evaluation

The physical conditions of facilities can be evaluated by two categories, namely technical and social/political criteria. The technical criteria are to determine the physical condition of the facilities of a certain type of infrastructure system. On the other hand, the selection process of facilities for rehabilitation projects is often politically or socially influenced at the community, city, or state levels. Each criterion in the technical and social/political level has several sub-criteria associated with it.

Level-2: Group Member Evaluation Module

At Level-1 of the analysis, a weighted value is determined for each criterion and sub-criterion. The weighted values indicate that each criterion has a different level of importance for facility evaluation. The group member evaluation module takes into account possible prejudice of evaluators in assigning the weighted values to criteria and sub-criteria.





Level-3: Field Evaluation & Cost Estimation

The rehabilitation costs for facilities are estimated by a Cost Estimator (ES) in the technical and social/political criteria level. The cost estimation is also based on the field evaluation score of the facilities in the aspects of technical and social/political criteria by a Field Engineer (FE). The field evaluation score and the rehabilitation cost of facilities in the criteria level will be used to facilitate the final ranking procedure and the decision-making process with respect to full or partial rehabilitation.

Level-4: Available Funds

Major funding for rehabilitation projects can be categorized as funding from capital programs and additional funding for technical and social/political criteria. The majority of funds for a capital program are obtained from the federal, state, and local governments while the additional funding comes from private developers and local businesses benefiting from infrastructure rehabilitation. The funds from capital programs will be allocated to the facilities by management considerations in Level-5. And, the additional funds are usually allocated funds for a specific facility or criterion.

Level-5: Management Considerations

This level is to optimize the facility selection for rehabilitation projects within the limited budget. The management considerations take account of 1) the priority for technical and social/political criteria as shown in Figure 2, 2) final ranking of facilities, 3) estimated cost for rehabilitation of facilities, and 4) funds available for rehabilitation through capital program and additional funding.

THE BENEFITS

- Reduction of time and efforts to make decisions,
- Integrated analysis of physical conditions of facilities, evaluation criteria, limited funds and other constraints,
- Easy communication between project members through the web-based application, and
- Application of group input from various stakeholders for more reliable and unbiased decision making.





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STATUS

ASPIRE has been developed to assist governing agencies to efficiently prepare a rehabilitation plan by the PURDUE ASPIRE Research Team in Construction Engineering and Management. The team is looking for potential purchasers in both public and private sectors as follows:

Public agencies at cities and local communities

- Department of Public Works for Infrastructure management,
- School Corporations for public school facilities,
- Corps of Engineers for vital public engineering services, and
- Other government agencies.

Private agencies

- Large corporations with multiple facilities, and
- Healthcare Service Providers

BARRIERS

Critical issues in the research and any disadvantages/tradeoffs of the technology

POINTS OF CONTACT

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REFERENCES

1. Yoon, Y., W. Kang, et al. (2009). A System for Rehabilitation Planning of Infrastructure Projects, Shanghai, China, ASCE.
2. Visit ASPIRE web site: <http://ace.ecn.purdue.edu/aspire/web>
3. Go for ASPIRE Demo:
[http://ace.ecn.purdue.edu/aspire/aspire\(web\)/video.aspx](http://ace.ecn.purdue.edu/aspire/aspire(web)/video.aspx)

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PUBLISHER

Emerging Construction Technologies, Division of Construction Engineering and Management, Purdue University, West Lafayette, Indiana

