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COMPUTER-INTEGRATED KNOWLEDGE SYSTEM (CIKS) NETWORK: REPORT OF THE 2ND WORKSHOP

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NIST

United States Department of Commerce
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National Institute of Standards and Technology

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Lawrence J. Kaetzel, Editor

EXECUTIVE SUMMARY

Increasingly, construction industry private and public organizations are placing greater emphasis and value on *data, information, and knowledge*[1]. Virtually every organization is an information provider and/or information consumer. For many private organizations, advertising, access to construction information and customer service is key to maintaining a competitive advantage. For government and academia, publishing and sharing research results electronically results in a significant advantage over previous methods such as printed materials. Though information technology has provided benefits in faster delivery and vast storage capabilities, it has not delivered significant improvements in searching, interconnecting, and interpreting information. This is largely due to the lack of consistency in representing and defining construction industry knowledge, the distributed nature of the knowledge, the contextual nature of knowledge that is very context dependent and the lack of resources to focus on these issues. The industry needs a non-biased organization that both produces knowledge and has the capabilities to develop and test methodologies and a unified framework. This effort must be performed in unison with construction industry associations and institutes, private companies, academia, and other government organizations. The National Institute of Standards and Technology (NIST) has been focusing on important knowledge issues that affect the representation, exchange, and understanding of construction industry materials, products, and systems through its Computer-Integrated Knowledge System Network (CIKS) program. Collaborative efforts with organizations such as the American Concrete Institute (ACI), The Society for Protective Coatings (SSPC), and the American Society for Testing and Materials (ASTM) have resulted in the development of methods to aid knowledge representation and exchange.

In 1996, the first CIKS workshop was held in Gaithersburg, Maryland. This workshop attempted to define the focus and goals of the CIKS program. Keynote presentations describing construction industry applications were given. Representatives from industry, government and academia met in construction materials and information technology working groups to develop agendas for further work, recommendations on collaborative efforts and funding and knowledge user needs. A NIST report titled "A Partnership for a National Computer-Integrated Knowledge Systems Network for High-Performance Construction Materials and Systems: Workshop Report" describing the agenda and results was published in March of 1997 [1]. As a result of the workshop, two CIKS *active* working groups emerged. These working groups representing the concrete and industrial coatings materials areas, began by focusing on three principal areas:

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[1] For the purposes of this report, *data* is represented by individual observations such as research results, *information* is organized *data* such as tables and directories, *knowledge* is represented as engineering guides and accepted practice such as rules developed by higher-level knowledge staff, such as materials experts. The term *knowledge* will be used in this report as a general term that may also include *data* and *information* except as specifically stated.

1. Investigation, testing, and adoption of relevant information technologies and knowledge issues facing the construction industry materials area.

2. The development of consistent methods, such as formats and terminology for aiding in the representation and exchange of knowledge.

3. Further development of decision support applications to aid in the use and understanding of construction industry knowledge.

The groups, working independently and with technical associations and institutes have jointly produced several industry standards and applications that address specific sponsor needs for knowledge representation and exchange and decision making and will also benefit construction industry organizations as a whole. These efforts include; guides and standards for the identification and representation of concrete constituent material properties, a guide for the representation and exchange of industrial coating product data, engineering decision support systems for bridge coating and concrete hydraulic structures, and methods for promoting the exchange of construction industry knowledge. These results are described in detail later in this report. In addition, the NIST CIKS staff produced a report on a proposed CIKS framework that was published in September 1997 [2].

During the process of investigating information technologies and user needs for CIKS, it became obvious that several critical factors hindered its success and for the program to provide significant gains, these factors must be addressed. These factors included:

- Existing knowledge bases are distributed and fragmented and costs for redesign are too great.

- The construction materials industry lacked consistent terminology and formats for representing electronic data.

- The construction materials industry lacked universal activity and process models for building unified or interoperable knowledge bases.

- The construction materials industry lacked criteria for evaluating knowledge.

Based on these factors and the need to advance the CIKS program, a 2nd CIKS workshop was held. The goals of this workshop were to focus on the critical factors stated above by bringing together organizations having active programs and projects that could provide synergy. This workshop was held in September 1997 and is the focus of this report. During the 2nd workshop, keynote presentations focused on the critical elements for knowledge interoperability and several working groups met to discuss their progress and to plan further work.

Today, the concrete and industrial coatings working groups remain active within committees of the American Concrete Institute and the Society for Protective Coatings, respectively. Also, NIST continues to pursue the CIKS goals in a more focused direction, namely, the Partnership for High-Performance Concrete Technology Program. Technical societies have adopted CIKS methodologies for knowledge sharing and organizations such as the Federal Highway Administration, Turner-Fairbanks Research Center and the U.S. Army Corps of Engineers are actively developing engineering decision-support systems for their structures.

The realization of CIKS has enormous potential for the construction industry. It will require increased collaboration between NIST, the private sector and other government organizations. NIST maintains a neutral position and can play an important role by assisting societies and institutes that need to address the needs of their constituents. Undoubtedly, further meetings and workshops will be necessary in order to present knowledge producers and consumers with innovative techniques and to ensure a synergistic approach. There remains a need to influence information technologists in the development of appropriate technologies that address the needs of scientific and technical information.

Finally, construction industry feedback on CIKS is vital and comments are welcome. This report is being made available in printed form as a National Institute of Standards and Technology Internal Report and is available on the CIKS website at the address: www.ciks.nist.gov.

The recommendations from the workshop were:

- A strawman should be developed based on the coatings and concrete working group activities. This strawman should have priority in the next phase in the CIKS development and should be presented at a future CIKS workshop.
- A future CIKS workshop should include greater representation from the construction industry user community.
- Working groups should continue to meet at 6 month intervals in order to maintain progress in their respective areas.
- The report from the workshop should be distributed to attendees and construction industry organizations interested in knowledge base activities.
- Industry should express its support to NIST for CIKS

ABSTRACT

The 2nd workshop on a National Partnership on Computer-Integrated Knowledge Systems (CIKS) Network for High-Performance Construction Materials and Systems (NPCMS) was held in Gaithersburg, MD on September 24th and 25th, 1997. The workshop was sponsored by the Building and Fire Research Laboratory of the National Institute of Standards and Technology, the Construction Materials Council of the Civil Engineering Research Foundation, and the American Society for Testing and Materials. The workshop mission was to:

> *Provide a forum for developing and participating in an industry-wide effort to address the information needs of private and public organizations within the construction industry.*

The workshop objectives were to:

- Identify and prioritize current and future information needs of the construction industry as they relate to construction materials and systems.
- Critique the proposed framework for developing and implementing CIKS.
- Identify and assess opportunities for private and public partnerships for developing CIKS.

In the pursuit of these objectives, experts representing private and public construction industry organizations and information technologists presented information on projects that comprised a major information representation and distribution component. Also, representatives from facility owners, technical associations and societies, consultants and engineers, and universities met in working groups to identify knowledge user needs and to critique the relevance of keynote presentations to their project and organizations goals. Two working groups; 1) concrete and 2) coatings developed substantial agendas and recommendations for pursuing the CIKS mission and objectives. The consensus of the group revealed that CIKS could significantly improve the distribution and use of electronically stored knowledge and that the concrete and coatings working groups should be a model for other working groups to pursue. This report presents information contained in the keynote addresses and results of the working group sessions.

Keywords: computer integrated knowledge system; construction industry; high-performance construction materials; information technology, knowledge interoperability, knowledge-based systems; workshop.

DISCLAIMER

The reference to commercial equipment, instruments, computer hardware and software in this report are identified in order to provide examples of experimental procedures and methodologies. Such identification is not intended to imply recommendation or endorsement by the National Institute of Standards and Technology, nor is it intended to imply that the materials or equipment identified are necessarily the best available for the purpose.

TABLE OF CONTENTS

4. Workshop Conclusions and Recommendations

The 2nd CIKS Workshop was a success from several prospectives, but not all. Information gained from the wrapup sessions and working group recommendations provided realistic projections on the direction and magnitude of the vast amount of work and collaboration required to make CIKS a successful knowledge based network for the construction industry. The primary points covered in the wrapup discussions and the consensus of the attendees are listed below.

4.1 Conclusions

Workshop attendance – Participants in the workshop were mainly representatives of facility owners, researchers, managers, and information technologists. A significant base of knowledge users was lacking.

Keynote presentations – Part I of the keynotes described important methods and information tools that are necessary for a distributed and heterogeneous CIKS system. The presentation on terminology raised awareness of the importance of this topic for knowledge sharing. Information sharing is complex and futuristic topic, but one that must be addressed in the CIKS environment. Actual demonstrations of prototype systems are essential to convey the information that can be digested and used by construction industry segments.

Part II of the keynotes involved discussions of actual applications for construction industry use. These presentations presented information that can be used by the workshop participants.

Critique of the CIKS framework – The vast scope of CIKS and its objectives made it difficult for some of the participants to relate to their particular needs. This demonstrates the need for partnership among organizations that are actively pursuing solutions to knowledge user needs and the need to team with information technologists to "interpret" information technology methodologies. The need for a strawman was obvious and the Coatings Working Group activities showed how one segment of the construction materials area is addressing key issues for knowledge use. Also, greater emphasis should be placed on the CIKS testbed to assist industry segments in testing and building prototype systems.

Working group results – Two of the working groups; coatings and concrete made significant progress during their breakout sessions: coatings in the area of addressing future work for developing decision support systems and creating partnerships and concrete, in the area of partnerships and the development of an agenda for sharing information and methodologies for pavement management systems and hydraulic structures.

The joint Composites and Geosynthetic Materials Group developed useful information that is necessary for defining their user needs and characterizing the CIKS system.

It was apparent that the assistance provided by members of the Information Technology Group during the working group sessions helped to explain the details of specific information tools for the materials specialists.

Expectations for future workshops – Perhaps the strongest justification for future workshops is the need to demonstrate applications and technologies to system developers, users, and mangers. These demonstrations would include organizations actively engaged in developing knowledge bases and who have legacy systems and those who are just beginning. Using a strawman and model systems should be considered as a core for future meetings. A major focus should be in the areas of coatings and concrete materials.

4.2 Recommendations

The main recommendations from the workshop concerned the CIKS framework and future workshops. They are:

- A strawman should be developed based on the coatings and concrete working group activities. This strawman should have priority in the next phase in the CIKS development and should be presented at a future CIKS workshop.
- A future CIKS workshop should include greater representation from the construction industry user community.
- Working groups should continue to meet at 6 month intervals in order to maintain progress in their respective areas.
- The report from the workshop should be distributed to attendees and construction industry organizations interested in knowledge base activities.
- Industry should express its support to NIST for CIKS

5. ACKNOWLEDGEMENTS

The workshop organizers very much appreciate the support from the sponsors which contributed to the success of the workshop:

The Civil Engineering Research Foundation (CERF)

The CERF Construction Materials Council (CONMAT)

The American Society for Testing and Materials (ASTM)

The National Institute of Standards and Technology (NIST)

They also wish to express their appreciation to the workshop participants for making the workshop a success. Special thanks to the keynote presenters and to the working group chairmen.

The workshop organizers thank the contribution by Janice Hagood for coordinating the workshop facilities and to the reviewers of this report.

Finally, the editor wishes to thank Mary McKnight, Geoffrey Frohnsdorff, Dale Bentz and Thomas Kurihara of NIST for their review comments, suggestions, and support in the development of this report. Also, Zhanmin Zhang of the University of Texas at Austin for his effort as WERB reviewer.

6. REFERENCES

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6. Kaetzel, L.J. and Kogler, R.A, “A Systematic Approach to Coating System Selection for Highway Bridges Using the BRCOAT Knowledge Based System,” Proceedings of SSPC ’98, Orlando, Florida, SSPC 98-11, pp. 10-19, Society for Protective Coatings, Pittsburgh, PA (November 1998).

APPENDIX A: WORKSHOP PROGRAM

Program
2nd Annual CIKS Workshop

September 24, 1997

8:00-8:30	Registration	
8:30-8:40	Welcome and Introduction	Lawrence Kaetzel (Workshop Chair)
8:40-9:00	Sound Decisions in Design, Construction and Use of Construction Facilities	Richard Wright, Director NIST, Building and Fire Research Laboratory

Keynote Presentations I: Building Blocks for Knowledge Exchange

9:00-10:30	The DARPA Approach to Knowledge Sharing	David Gunning, Program Manager, (DARPA) Defense Advanced Research Projects Agency
	Terminology: Need for Consistency and Current Efforts to Standardize	Sue Ellen Wright, Kent State University
	Tools for Knowledge Sharing	Timothy Finin, University of Maryland Baltimore Campus
	Electronic Commerce for the Engineering Enterprise	James Andrew Arnold Center for Integrated Facility Information, Stanford University
10:30-10:45	Break	

Keynote Presentations II: Knowledge Exchange Efforts and the CIKS Framework

10:45-12:15	Society for Protective Coatings (SSPC) Coating Knowledge Center	Dr. Bernard Appleman, Executive Director, Society For Protective Coatings
10:45-12:15	Construction Supernetwork	Alan Sparkman, Publisher Aberdeen Group, Electronic Media Division

	Life-Cycle Computer-Aided Data Project	Ken Humphreys Pacific Northwest Laboratory
	CIKS Framework and Testbed	Tom Kurihara, Computer Specialist, NIST, Building and Fire Research
12:15-12:45	Panel Discussion	
12:45-1:00	Charge to Material Working Groups	J. Meyer (Workshop Co-Chair), Director, Research and International Programs, CERF
1:00-2:00	Lunch	
2:00-5:00	Material Working Groups: Session I Goal 1: Identify user needs Goal 2: Critique CIKS Framework	
5:00-5:15	Break	
5:15-5:45	Summary of Working Group Sessions (Working Group Chairs)	
6:30	Cocktails (cash bar)	
7:00	Dinner	John Rumble, Chief NIST, Office of Standard Reference Data

September 25, 1997

8:30-9:00	Plenary Session Preliminary reports from material working groups
9:00-12:30	Material Working Groups: Session II Goal 1: Opportunity assessment, develop recommendations Goal 2: Develop working group reports
	Information Technology Working Group: Session I
12:30-1:30	Lunch
1:30-2:30	Summary, wrapup and next steps
2:30-5:00	Tour and demonstrations of NIST/CIKS test bed
5:00	ADJOURN

APPENDIX B: SPONSORING ORGANIZATIONS, STEERING AND ORGANIZING COMMITTEE MEMBERS

Sponsoring Organizations

- Civil Engineering Research Foundation (CERF)
- Construction Materials Council (CONMAT), CERF
- American Society for Testing and Materials (ASTM)

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Douglas Barno, SPI Composites Institute
Timothy Finin, University of Maryland, Baltimore County
David Fowler, University of Texas at Austin
Geoffrey Frohnsdorff, NIST/BFRL
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Larry Kaetzel, NIST/BFRL
Gil Kaufman, The Aluminum Association

Organizing Committee

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