# Tufts University Sciences Knowledgebase (TUSK): Improving Health Sciences Education and Teaching Through Technology

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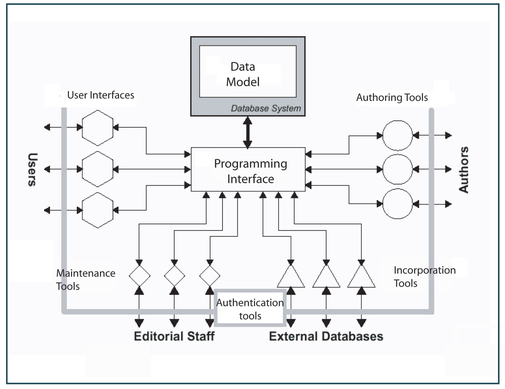
## INTRODUCTION-PURPOSE

Tufts University Sciences Knowledgebase (TUSK) is an award-winning, dynamic multimedia knowledge management system, built on Open Source software. The system was designed to support faculty and students in teaching and learning. **TUSK provides a portal to an integrated body of knowledge and ways to personally organize the vast array of health information through its online curricular materials and related applications.** Initiated in 1995 with National Library of Medicine funding, the system can provide the infrastrucure and user tools for global sharing of content.




***Overall Architecture of TUSK Components***

The core of the TUSK structure is its data model and programming interface. All other components rely on these to provide data access. Our model represents three kinds of data; curricular content, administrative information, and user-created content, and the rich relationships among these elements. Authentication tools (including Shibboleth[1]) enable collaboration across institutions to author and share content.

## TUSK SERVER CONFIGURATION ADAPTATION

TUSK adapts from multiple to single server configurations based on institutional needs and resources

***Tufts University School of Medicine***

*Production Servers*
- Web
- Database
- Media
- UMLS/Indexing
- Log
- Jumpstart
- Console

*Disaster Recovery Servers*
- Web
- Database

*Test Servers*
- Web/Database

*Development Servers*
- Web/Database

**New York Medical College**

*Production Server*
- Web/database

*Development Server*
- Web/database

**University of KwaZulu-Natal**

*Production Server*
- Web/database

## GLOBAL INFORMATION SHARING

TUSK enabled transfer of HIV/AIDS educational content from University of California San Francisco to University of KwaZulu-Natal, Durban, South Africa

## RESULTS

***Key elements and minimum specifications for successful adoption/use of TUSK:***

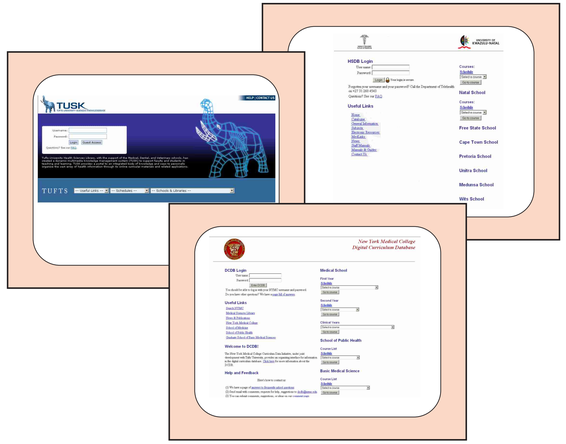
1) Collaboration of personnel within institutions
   - *administration*
   - *technologists*
   - *user support/users*
2) Identifying or contracting resources for system installation and maintenance
3) Appropriate sizing of server(s) configuration and acquisition of hardware
4) Development of internal expertise for on-going user support

***TUSK provides a collaborative and integrated teaching and learning environment:***

1) Searching & indexing content using UMLS[2] across all health sciences curriculum
2) Content repository capable of supporting full multimedia
3) Course authoring and management tools
4) XML-based authoring for semantic mark up
5) Web-based content management system
6) User portal, including personalized content delivery and knowledge management
7) Built in student self-assessment and course evaluation
8) Support for integrated medical curricular needs

***TUSK uses Open Source software to promote co-development and sharing of new tools***

1) Institutions can select the specific modules of user tools it needs
2) Code can be customized to integrate with specific institutional administrative systems and work processes
3) Compliant with Open Source standards such as OKI[3] and IMS[4]
4) Participation with Open Source consortia such as Shibboleth, Internet 2, and Sakai[5]




## CHALLENGES

- Creating non-Tufts-specific code and implementation tools for new sites
- Developing processes and procedures to maintain technical upgrades across institutions
- Integrating with other open source efforts, such as Sakai and OKI
- Managing user expectations during installation and development
- Providing adequate hardware and technical support in other countries
- Securing funds for increased production and development

## SUMMARY OF CONCLUSIONS

Despite the above challenges, use of database-driven technology such as TUSK presents a global opportunity for knowledge sharing by developing a collaborative open source infrastructure, decreasing the information gaps that exist between both institutions and countries, and ultimately enabling adoption of international standards for health sciences education.

## FUTURE DIRECTIONS FOR DEVELOPMENT

- Abstract the TUSK code so that it is universally applicable to any academic environment
- Adopt a digital rights management system, using either ODRL[6] or XRML[7]
- Incorporate Shibboleth authentication to enable selective sharing of content with other institutions
- Conform with developing open source standards- IMS, Sakai, OKI, SCORM[8]
- Create *hooks* from TUSK to the programming interfaces made available from Sakai, Fedora[9], and other projects
- Develop a TUSK consortium of co-developers
- Enhance TUSK infrastructure to provide seamless access to external data sources, such as digital libraries and publishers

## REFERENCES

**1. Shibboleth**
Shibboleth, a project of Internet2/MACE, is developing architectures, policy structures, practical technologies, and an open source implementation to support inter-institutional sharing of web resources subject to access controls.
http://www.shibboleth.internet2.edu/

**2. UMLS**
The purpose of NLM's Unified Medical Language System® (UMLS®) is to facilitate the development of computer systems that behave as if they "understand" the meaning of the language of biomedicine and health. To that end, NLM produces and distributes the UMLS Knowledge Sources (databases) and associated software tools (programs) for use by system developers in building or enhancing electronic information systems that create, process, retrieve, integrate, and/or aggregate biomedical and health data and information, as well as in informatics research. http://www.nlm.nih.gov/research/umls

**3. OKI**
The Open Knowledge Initiative™ is a collaboration among leading universities and specification and standards organizations to support innovative learning technology in higher education. http://web.mit.edu/oki/

**4. IMS**
The IMS Global Learning Consortium develops and promotes the adoption of open technical specifications for interoperable learning technology.http://www.imsglobal.org/

**5. Sakai**
The Sakai Project software development project founded by The University of Michigan, Indiana University, MIT, Stanford, the uPortal Consortium, and the Open Knowledge Initiative (OKI) with the support of the Andrew W. Mellon Foundation. The project is producing open source Collaboration and Learning Environment (CLE) software. Tufts is a member of the the Sakai Educational Partners Program (SEPP). http://www.sakaiproject.org/

**6. ODRL**
The Open Digital Rights Language (ODRL) Initiative is an international effort aimed at developing and promoting an open standard for the Digital Rights Management expression language. http://odrl.net/

**7. XML**
XrML - eXtensible rights Markup Language - is a Digital Rights Language. XrML provides a universal method for securely specifying and managing rights and conditions associated with all kinds of resources including digital content as well as services. http://www.xrml.org/

**8. SCORM**
The Sharable Content Object Reference Model (SCORM) is part of a strategy called the Advanced Distributed Learning Initiative. The primary sponsors are the US Dept of Labor, Defense Dept, and the National Guard Bureau. SCORM is a suite of technical standards that enable web-based learning systems to find, import, share, reuse, and export learning content in a standardized way.
http://www.adlnet.org/index.cfm?fuseaction=scormabt

**9. Fedora**
The Fedora project was funded by the Andrew W. Mellon Foundation to build an open-source digital object repository management system based on the Flexible Extensible Digital Object and Repository Architecture (Fedora).
http://www.fedora.info/