

Abstract

Whole slide images (WSI) are digital images of entire glass microscope slides. Rapid advances in technology have resulted in reduced cost and increased quality of these systems. Cost justification and funding are significant challenges in implementing WSI technology. This study details our institutional experience with the planning, funding, and justification of WSI systems including a discussion of both real and hypothetical strategies. Careful pre-planning is essential. One must define: 1) user profiles and practices; 2) system's purpose; and 3) required implementation resources. Different users will have unique workflow requirements that should be accommodated. Explicit knowledge of the system's scope and intended use will facilitate the entire process including documentation of benefit and cost justification. Understanding of required resources is essential for successful implementation. For example, compare an automated high-capacity "mission-critical" system versus a small teaching resource. Although research funding is a traditional method of financing new experimental systems, it may not be appropriate for clinically-oriented systems. Departmental or institutional funds require rigorous cost justification, however. Careful effort to document cost savings, generated revenue, and/or improved patient care is necessary as learnt from our experience. Successful implementation of WSI-based systems is challenging but has the potential to dramatically change pathology practice.

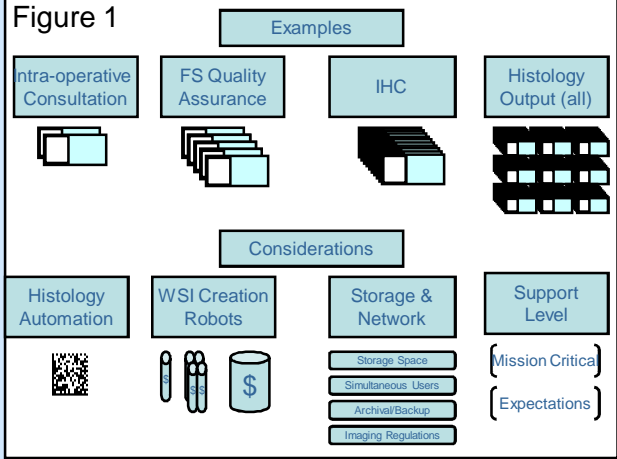
Background

In this context, digital pathology refers to applying imaging technology to pathology practice. Examples include digital photography, robotic telepathology systems, image analysis, and whole slide images (WSI). WSI are of particular interest because they could serve as a proxy for a physical glass microscope slide.

WSI technology has progressed to the point that new applications are becoming feasible including: electronic distribution of immunohistochemistry stain information; quality assurance; intra-operative consultation; and image analysis. Although some of these applications do not require WSI, this technology can permit increased automation (work distribution; automated image analysis; etc.).

To date, it has been difficult to develop a robust business case for WSI technology, despite "common sense" notions that such images could revolutionize pathology practice through enhanced automation (technical and professional components) and telepathology.

Figure 1



Design

Framework should include: 1) purpose of application; 2) target users; 3) cost justification (e.g. the business case). Planning should address practical factors such as support ("mission critical" versus "optional"), workflow, user expectations (always-available, high performance), and security.

Non-cost justifications include: increased "quality" (i.e. QA); enhanced archival of "precious" slides (FS; cytology); convenience (esp. across multiple sites); increased access (simultaneous users); quicker access to distant services (IHC) or consultants; and "marketing" (both public and intra-organizational).

Financial justifications can include: making use of existing WSI equipment/personnel (i.e. new use of "old" system); decreased shipping cost; and revenue (includes indirect revenue that can be attributed to WSI use). IHC image analysis may be a "foot in the door" in terms of revenue.

Funding sources can also include unusual sources such as other clinical departments and government agencies (e.g. for provision of services to underserved regions). WSI resources can also be acquired in a "piggyback" fashion—using generic "image" servers to host WSI or using a telepathology system for low-volume WSI creation.

Results

Our WSI efforts fall into three categories: education; clinical applications development; and quality assurance (frozen section QA). The majority of these are low volume applications that are not "mission critical" in terms of support/availability.

Funding now includes research grants and institutional funding; one of our two current WSI systems is funded by the pathology department for telepathology purposes. Our image servers contain (as of 5/1/07) nearly 7,800 WSI.

Conclusions

- Implementation requires careful planning - real world requirements can differ widely.
- Cost justifications could include: decreased costs, increased revenue, increased efficiency and increased safety.
- Documentation of cost justification results could lead to increased adoption ("foot in the door").
- Applications are spreading beyond traditional (education) into clinical applications (immuno stains; intra-operative consultation; second opinion).
- A "killer app" is still in the future.

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