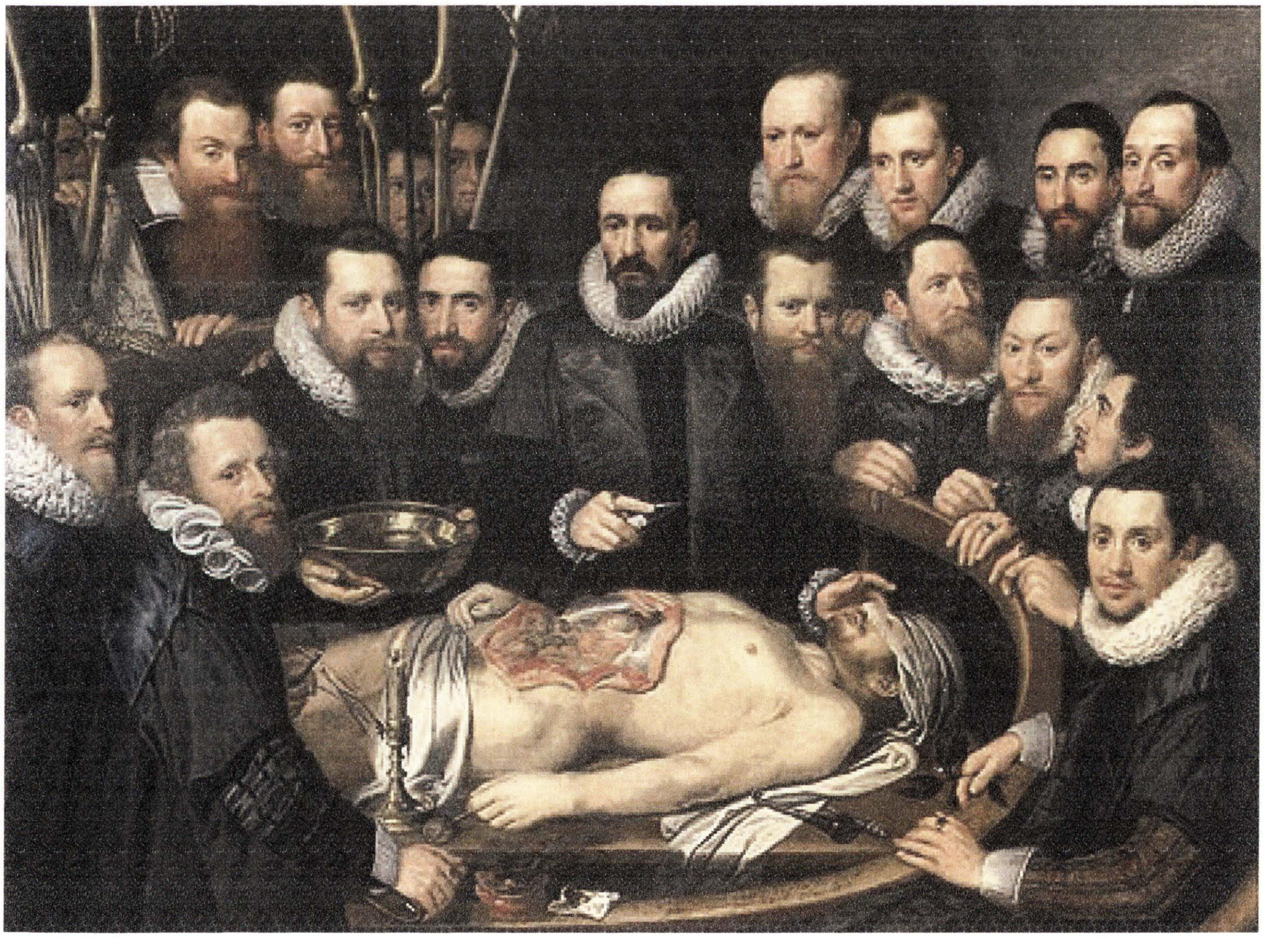
UNIVERSITY OF TECHNOLOGY, SYDNEY: FACULTY OF DESIGN, ARCHITECTURE AND BUILDING
MASTER OF DESIGN (BY THESIS)

A study of the Design Considerations and Emerging Technologies in the area of Major Surgical Lighting



Sinclair Park

JUNE 2007

CERTIFICATE OF AUTHORSHIP/ORIGINALITY

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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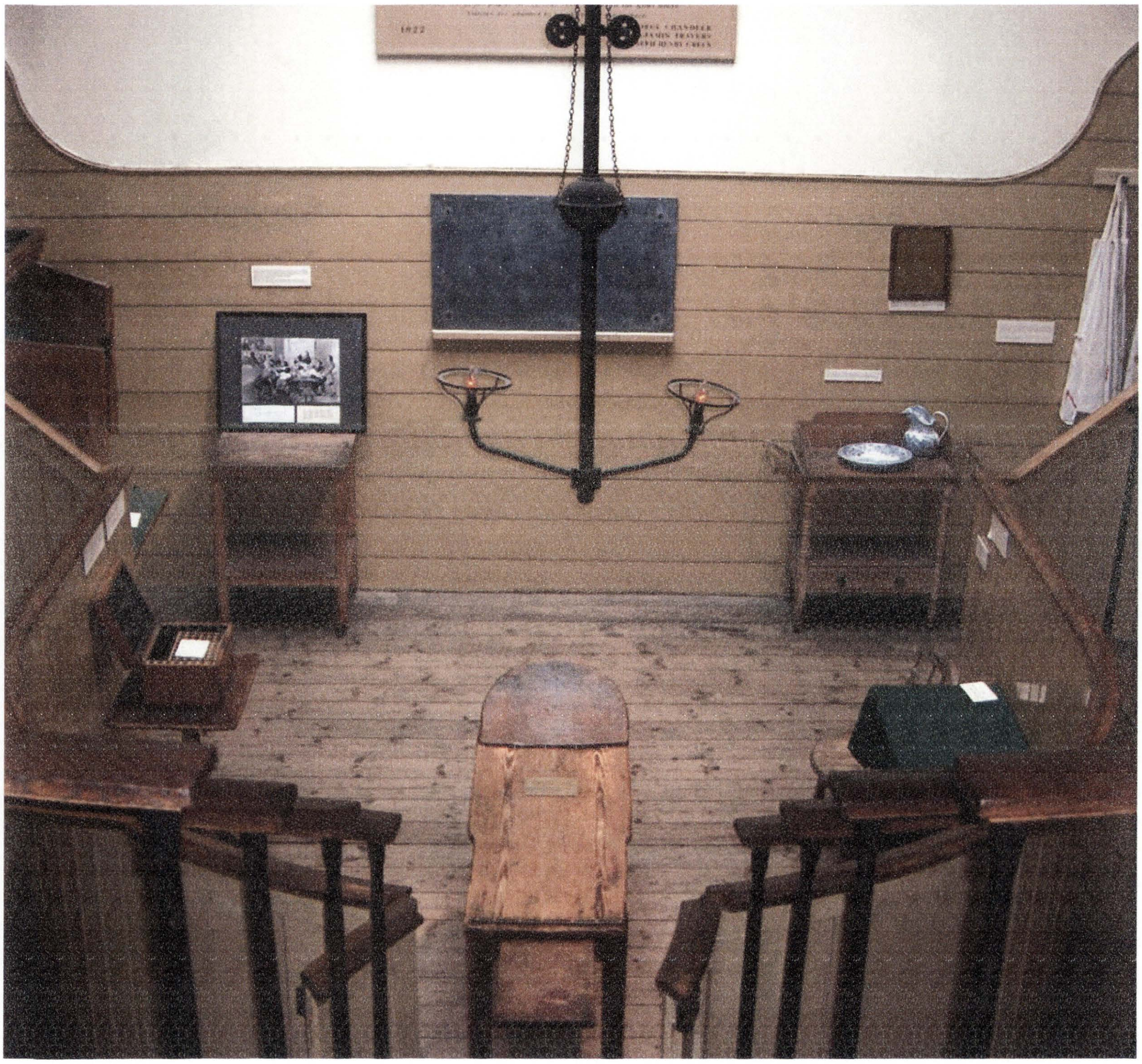

Figure a). Operating theatre and light dating back to 1822, St Thomas's, London.

Glossary

M.S.L.	Major Surgical Lighting
L.A.F.	Laminar Air-Flow
C.F.D.	Computational Fluid Dynamics; computer based fluid dynamics modeling
Lux (lx)	SI unit of illuminance; One lux is equal to one lumen per square metre, where 4π lumens is the total luminous flux of a light source of one candela of luminous intensity.
Photo-toxicity	harmful effects of light inc. UVB and UVC radiation
IR	Infrared
UV	Ultraviolet
CRI	Colour Rendering Index; a measure of the ability of a light source to reproduce the colors of various objects being lit by the source , developed by the International Commission on Illumination
HEPA	High Efficiency Particulate Arresting Filter; typically removing 99.97% of all air borne particles larger than 0.3 µm
OR	Operating Room
Laminar flow	fluid flow in parallel layers, with no disruption between the layers
Collimated	light with parallel rays
NA	Numerical Aperture; a dimensionless number that characterizes the range of angles over which the system can accept or emit light
Asepsis	the practice to reduce or eliminate contaminants from entering the surgical field

ABSTRACT

The basic principles of Major Surgical Lighting (M.S.L.) have not changed significantly in the last 80 years; one or more light sources located in front of a large diameter reflector(s), suspended over the patient with some ability for positioning and focus. However, over the same period, surgical procedures and methods have progressed dramatically, as have other areas of operating theatre technology.

There have also been many other developments in the field of general lighting technology that may be useful in M.S.L. that to date, have not been fully explored. New research was needed that looked at the design considerations of M.S.L., taking into account these advancements, exploring any challenges or opportunities they presented.

Current literature and research in the field of surgical lighting and related issues has been investigated and summarised. This research revealed that perhaps the most pressing design issue of M.S.L. has been created by advancements that have been made in other areas of Operating Theatre technology. The use of ultra clean Laminar Air-Flow (L.A.F.) systems, which have been shown to reduce post-operative infection by up to 50%, has been becoming more prevalent since the technology was first introduced in the 60's. However, a number of studies have also shown that the effectiveness of any laminar flow system is severely compromised by current surgical lighting design.

This research proposes the use of flexible light-guides to enable the remote location of the light source, thereby greatly reducing both the heat output and physical disruption to any L.A.F. system. New opportunities for improvements in light delivery such as adjustable spectral distribution, and dimming with the colour temperature remaining stable are explored.

Computational Fluid Dynamics are used in order to compare and evaluate existing and proposed M.S.L. designs in relation to their disruption to L.A.F. systems. It is shown that the proposed light-guide system causes negligible disturbance to laminar flow when compared with current designs, therefore further reducing rates of post-operative infection.