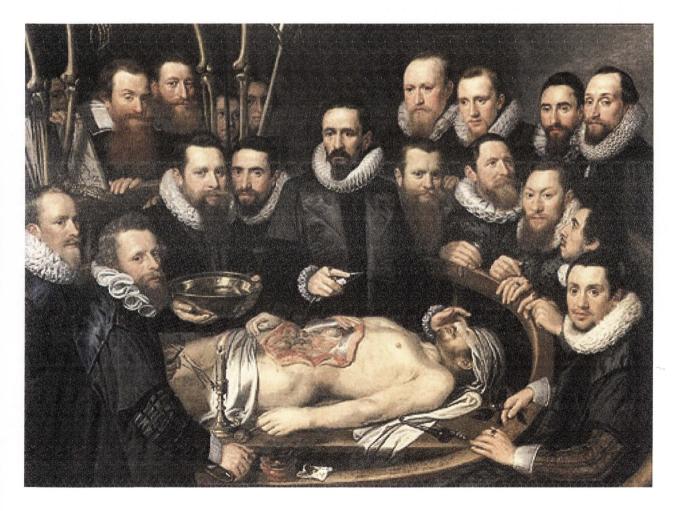
# A study of the Design Considerations and Emerging Technologies in the area of Major Surgical Lighting



Sinclair Park

**JUNE 2007** 

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-	certify th	at the w	ork in th	is thesis	has	not pre	eviously	been	subr	nitte	d for
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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

 $4\pi$  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**

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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.