Panasonic
BUSINESS

Laser projection for higher education

Whitepaper by ROI team

Proving the capability of Panasonic laser projection in higher education

Executive summary

Task

Evaluate the performance of Panasonic's laser projector, the RZ670 (rating 6,500 lm), against a range of the bestselling lamp-lit projectors in higher education:

Museums & Galleries

Higher Education Organisations

Rental & Staging

The following pages are an extract from the RZ670 laser projection whitepaper, focusing on the results for the higher education sector. The evaluation was conducted across a lifetime of 20,000 hours and against two performance measures:

Financial – Lifetime Cost of Ownership
Environment – Lifetime Carbon Emission

The results presented after will refer to 6500 lm laser projector.

Technical summary

The latest generation of laser-light projectors delivers much enhanced brightness, making laser projection a reality for the largest lecture theatres and seminar rooms in higher education.

ROI team has already demonstrated the operational superiority of laser technology in various aspects including:

- Superior cumulated light output
- Maintenance free lifetime of 20,000 hours or more
- Power consumption adjustment
- Instant on/off capability
- Installation versatility
- Reduced environmental impact

In addition to these attributes the Panasonic 6500 lm laser projector incorporates:

Flexible operational mode
Operator can now select to maintain brightness at a desired level

Superb colour and brightness
Across the colour spectrum, not just for white projection

Automated Geometric Alignment function
Saving the technician time at location (optional upgrade ET-CUK10)

Computer driven colour/brightness adjustment function
Again saving technician time at location (optional upgrade ET-CUK10)

Commercial analysis

ROI team's evaluation has highlighted important operational and commercial gains for the higher education sector under analysis by adopting laser projection systems:

Higher Education

- Instant on/off function maximises room-sharing arrangements
- Maintain comfortable room conditions for attention and learning

Lifetime performance evaluation

Higher Education

Lifetime Cost of Ownership

Taking into account all costs associated with the purchase and effective operation of a projector for this sector we find a clear advantage for the Panasonic 6500 lm laser projector compared with a range of lamp-lit projectors:

- Panasonic 6500 lm laser projector: €13,551
- Conventional projectors: €15,259

Although the initial purchase price may be higher, lifetime freedom from maintenance and lamp changes gives the Panasonic 6500 lm laser projector a Lifetime Cost of Ownership **11% lower** than a range of conventional projectors of equivalent brightness.

Lifetime Carbon Emissions

In terms of carbon emissions the lifetime comparison between the two projector types shows:

- Panasonic 6500 lm laser projector: 4.76 tonnes
- Conventional projectors: 6.40 tonnes

Across its lifetime the Panasonic 6500 lm laser projector produces only **74% of the carbon emissions** of a conventional projector of equivalent brightness.

1. Brighter, faster visual communication Laser projection steps up to a new level

In our whitepaper 'Clear Advantage for Lamp Free Projectors', released at ISE 2013, we evaluated the benefits and prospects for an interim generation of projectors, represented by the Panasonic PT-RZ370. This hybrid combines the best available attributes of both lamp-lit and laser technology, to provide a laser-lit projector with an extended maintenance-free life of 20,000 hours.

Brightness capability is a convincing 3,500 lm, making this the first laser-lit projector with sufficient brightness to operate in public access environments.

Since that study Panasonic has taken laser technology to a new level, introducing the Panasonic 6500 lm laser projector family in 2014. This projector series boasts all of the attributes and features seen in the PT-RZ family, but with initial brightness of 6,500 lm laser technology, is now suitable for professional use in all but the largest arenas and for the whole range of indoor halls.

This progress into larger spaces benefits the higher education sector where projectors create the backdrop that enhances engagement in lectures and seminars. Projectors used in this environment need exceptional brightness, colour, clarity and dependability. Higher education professionals look for ultra-reliable projectors that are easy to operate and perform as the ideal support tool to the delivery of teaching.

Here the gain in brightness enables projectors to be used in lecture theatres and classrooms and in near daylight conditions to enrich the students' experience.

I. TECHNICAL ANALYSIS

2. Advance of laser-lit technology

Laser-lit technology has already proved its superiority to lamp-lit in many ways. Now it is suitable for professional use in bigger and bigger spaces.

Technical analysis

Laser technology, in the form of the Panasonic 6500 lm laser projector, has clear advantages for the higher education sector, which will be detailed in following sections.

Suggested usage of laser projection vs lamp-lit projectors

	Lamp-Lit	Dual	Laser-Lit
HIGH EDUCATION	Classroom	Seminar room	Lecture hall

Advantages of laser as a light source

The use of the projector as a tool for public-facing visual communication and teaching has been restricted by performance limitations of the conventional lamp-lit projector including:

Lamp life

A projector requiring a lamp is subject to the decay curve associated with the conventional bulb. Manufacturers recommend that a bulb is no longer functional and must be replaced when brightness falls to 50% of initial output meaning that, according to their recommendations, the bulb must be renewed at some point between 1,500 and 6,000 hours depending on the model.

In a higher education setting a projector might be in use 60 hours per week for 45 weeks a year, it can be seen that the university must budget for a lamp-change at least yearly – or face deterioration and possible failure of essential teaching equipment. It is also relevant to consider that, as the Panasonic 6500 lm laser projector has a life of 20,000 hours, this estate manager may need to budget for 10 or more lamp changes to keep their lamp-lit projector operational for the same period. Depending on the usage, similar calculation can be made for the higher education sector.

Warm-up/cool-down time

Conventional lamps need to be operated within a very specific temperature range to avoid damage to the lamp. For this reason a conventional projector needs a warm-up time of up to two minutes before it can achieve operational brightness; it's also essential that it must remain connected to the power supply during cool-down time to ensure its fans continue to cool the bulb.

Not surprisingly these requirements make the conventional projector cumbersome in the context of a fast-moving teaching session. The tutor must either keep the projector switched on throughout his lecture, and accept an uncomfortably hot and possibly darkened room – or accept a pause of two minutes before he can respond to a student's question. Either way he must switch off the projector five minutes before the end of the lecture to ensure it can be fully cooled before he vacates the lecture room for the next class.

A laser projector on the other hand operates at a much lower temperature and provides instant-on/off and power-saving shutter technology.

Power consumption adjustment

Conventional projector lamps run at 100% of their power requirement, producing 100% of their brightness capability, regardless of the brightness of the image they are projecting. For darker contents the additional light projected to the screen is either absorbed within an optical engine, or reflected away from the light path. Both systems produce additional heat which is dissipated from the projector.

Laser diodes on the other hand are dimmable light sources for a superior contrast ratio. They use 100% power only when full brightness is called for – i.e. a 100% white picture. To project a typical mixed output of darker pictures a laser light source will automatically reduce its power consumption – and heat output.

It can rapidly be seen that the laser projector represents a major advance in operational efficiency and flexibility.

Laser light source

- Light source life span will last more than 20,000 hours
- 20,000 hours maintenance free lifetime
- Dust-resistant optical parts do not require filters
- Operates at much lower temperature, requiring less energy
- Instant-on/off technology reducing power consumption and making projector instantly usable
- More eco-friendly
- Adjusts power consumption according to room lighting and brightness of the image

Lamp as light source

- Bulbs no longer functional after brightness falls to 50%
- Lamp-life range: 1,500 to 6,000 hours
- Needs up to 13 lamp changes during 20,000 hrs lifespan
- Need to change or clean filter to keep optical parts free of dust
- Needs up to 20 costly maintenance visits during 20,000 hours lifespan
- Warm-up time up to two minutes
- Cool-down time five minutes or more
- Remains connected to power supply during cool-down time, increasing power consumption
- Bulb contains mercury and other toxic materials
- Runs at 100% power requirement at all times, causing additional heat output

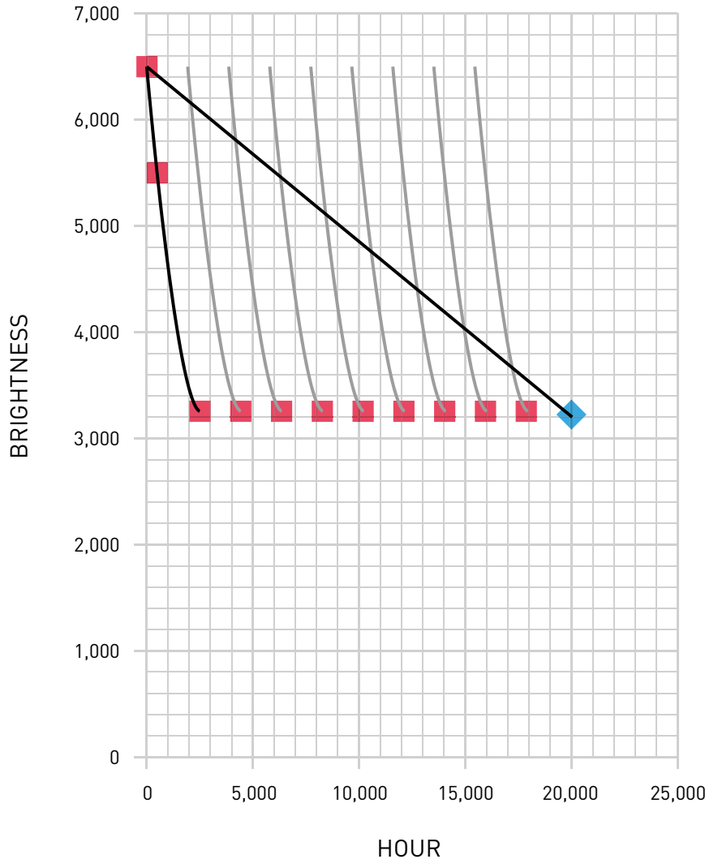
3. Brightness decay and its impact on bulb life

All types of light source (car headlights, household bulbs, etc.) exhibit brightness decay and a limited lifetime. They are consumable items.

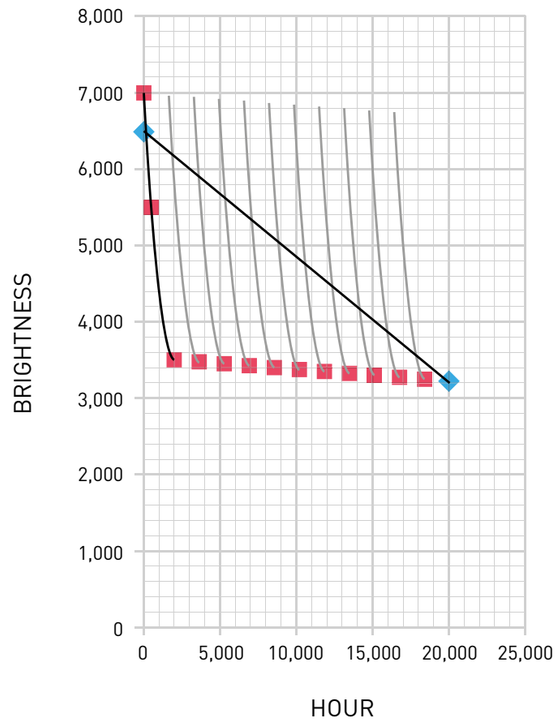
Conventional projector lamps show a Regressive Decay. This means that a lot of initial brightness is lost in the early hours of operation. The decay curve then flattens out before finally reaching 50% of initial brightness, at which point the bulb is no longer functional and must be changed. This means that a conventional projector bulb will spend as much as half of its life operating at close to half of its full capacity.

A laser light source on the other hand, displays a **Linear Decay** – so the projector loses operational brightness much more slowly and in a steady decline. This means that soon after starting its lifetime a laser projector will be providing more brightness than its equivalent conventional lamp-lit projector.

The latest Panasonic models incorporate a **Brightness Priority Setting** which enables near to full (above 80%) brightness to be maintained – albeit at the cost of shortening the operational lifetime of the projector. Panasonic are currently working to make this setting, currently available only as a factory setting, available to professional end-users.



The graph opposite shows the brightness output of two projectors, both with an initial rating of 6,500 lm: one a conventional lamp-lit projector, the other a laser projector. It can be seen that the brightness of the lamp-lit model rapidly falls below the Solid Shine model. Even after an expensive bulb change, the conventional model matches the performance of the Solid Shine model only for a short time.



Where we compare the performance of a conventional projector rated at 7,000 lm against that of a Solid Shine model rated at 6,500 lm it can be seen that, because of the **Regressive Decay** pattern of the lamp-lit projector, after only a short period of use, the Solid Shine model is operating at a superior level of brightness. In the attached graphic, the brightness of the lamp-lit 7,000 lm projector falls below that of the Panasonic 6500 lm laser projector after just 159 hours of use.

4. Cumulated light output

The best known and most widely accepted method to measure projector brightness is the ANSI Lumen specification devised by the American National Standards Institute (IT7.227-1998) which considers not only brightness, but also the uniformity of brightness as projected on a screen.

However brightness ratings following the ANSI model or any other specification are time-specific measurements which cannot track differences in brightness decay. Historically, this limitation has been acceptable because all projectors used similar technology and so followed a similar **Regressive Decay** path.

However, as observed above, the development of the laser projector now introduces alternative technology and the entirely different **Linear Decay** path. This means that a laser projector delivers a higher level of brightness or a greater proportion of its operational life.

To make a meaningful comparison between projectors using such different light sources, we need to evaluate brightness output over the lifetime of the projector. The cumulated light output can be expressed by the equation:

BRIGHTNESS (ANSI LM) X HOURS OF OPERATION = CUMULATIVE LIGHT OUTPUT

The **Panasonic 6500 lm laser projector produces 12% more brightness** than a conventional projector of the same initial brightness that may require four or more lamp changes within its 20,000 hours operating lifetime.

When benchmarked against a conventional projector with ANSI rating of 7,000 lm, the **Panasonic 6500 lm laser projector still produces 10% more brightness across the same period.**

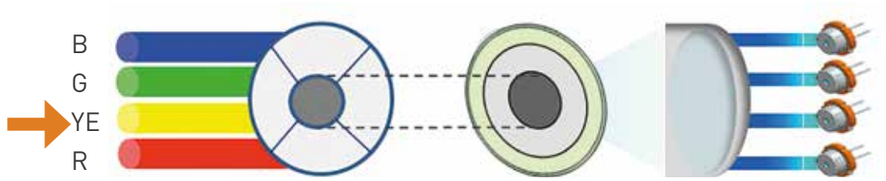
A projector is chosen for a specific application (such as a lecture hall) according to lighting conditions, and the brightness required to run the material. Requirements may include comfortable and stress free attention to teacher presentations in daylight conditions, or maybe crisp and clear reproduction of content in higher education context.

The Panasonic 6500 lm laser projector **with an initial brightness of 6,500 lm** ANSI produces more brightness over the same period than a conventional projector measured initially at 7,000 lm. Therefore both are suitable or the same applications and can be considered equivalent models.

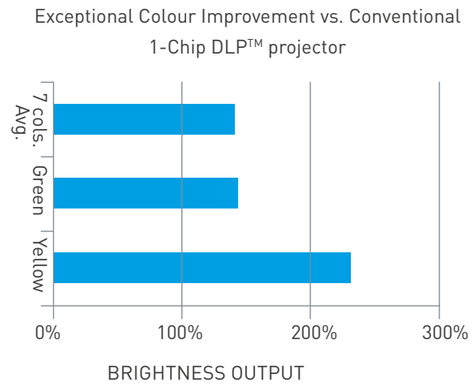
5. Brighter and clearer colour reproduction

The Panasonic laser projector surprises with a rating of ANSI 6,500 lm providing outstanding brightness of natural pure white at a duv value of just 0.006 – just ¼ the duv value of lamp-lit competitors.

Supplementing this white brightness the Quartet Colour Harmoniser (Colour Wheel plus Phosphor Wheel) ensures exceptional clarity right through the BGYR spectrum. Uniquely the Panasonic 6500 lm laser projector uses a four colour wheel, with white created by combination of the four colours.



Not only does this make the colour more balanced it also contributes to a higher perceived brightness as the brightness output per colour channel is significantly increased. Another reason why the Panasonic 6500 lm laser projector can perform well against projectors of a higher brightness category.



II. COMMERCIAL ANALYSIS

Technical analysis of the capability and performance of the Panasonic 6500 lm laser projector, set out previously, is derived from sector analysis and in particular work and analysis by Panasonic engineers working in laboratory conditions.

To evaluate the performance of the Panasonic 6500 lm laser projector in the commercial arena ROI team gathered data for the performance of the Panasonic 6500 lm laser projector against a range of lamp-lit projectors most purchased for each of three key sectors:

Higher Education
Museums & Galleries
Rental & Staging

Data and understanding derives from various methods:

1 Questionnaire-based survey of sector professionals across 10 European territories targeting:
   - Resellers and dealers exposed to the museums, galleries and higher education sectors

2 Depth interviews with the above groups

3 Performance and cost data was derived from manufacturers' product specification sheets

4 Futuresource (www.futuresource.com) provided data concerning sales volumes and actual selling prices for projectors in the relevant sectors

We now examine performance and contribution of the Panasonic 6500 lm laser projector to the higher education sector.

6. Breakthroughs for the Higher Education Sector

The higher education sector becomes more and more commercial in its approach. As student numbers increase so do class and seminar groups, so that teaching takes place in larger rooms with some students further from the lecturer. Teachers and lecturers depend more on centrally produced material to deliver modules and subjects.

The ability for teachers and lecturers to swiftly illustrate a point or clarify an issue with reference to a visual or with use of video material is now a necessity, not a luxury. Projectors are being developed to deliver this important enhancement and to do so in larger rooms and in brighter conditions.

Laser models like the Panasonic 6500 lm laser projector allow almost instant On/ Off operation, even in large lecture halls in bright conditions. No longer any need to close blinds or turn down the lights, nor to pre-schedule projector use to allow for warm-up time, and to end a lecture early to allow for cool down before the close of the session.

Now many HE Institutions are open for teaching throughout the week and throughout the year, with evening classes, weekend courses, vacation schools and conferences all reducing opportunities to close rooms for maintenance. Every closure reduces opportunity for the Institution to run classes and maximise use of facilities.

Advantage of laser projectors in the higher education vertical

Key factors for use of projectors in a higher education setting include:

Optimise room sharing

Today higher education institutions host a veritable merry-go-round as teachers and students circulate from room to room, often spending only an hour in a teaching room or auditorium before it must be vacated to make way for the next lecturer and class.

Lamp-lit projectors make this process cumbersome and inefficient as time is wasted at the start of a session to switch on and warm up the projector, with further time allowed at the end for the projector to cool down. Worse, if the projector is not allowed to cool under power it can suffer serious damage. Laser technology on the other hand offers virtually instant-on / instant-off process, as only minimal heat is accumulated in the light source.

Comfortable room environment

Students will tell you it is hard enough to stay alert during a one-hour lecture without the narcotic effect of heat and noise given out by a lamp-lit projector running in a darkened room.

The latest laser-lit projectors give out much reduced levels of both heat and noise and have sufficient brightness to operate in normal indoor light conditions. Today the Professor has no excuse if his students are nodding off; he needs to review his material!

Reducing environmental impact

Higher education organisations have a history of leading the way in demonstrating environmental responsibility. They will surely welcome a projector that requires no maintenance over a life of 20,000 hours and does not imply repeated disposal of environmentally harmful bulbs.

7. Conclusions

Sector professionals such as resellers/dealers and experienced end-users welcome the user-friendly qualities of Panasonic's lamp-free projectors:

- 20,000 hours maintenance-free lifetime
- Always ready for use, never in the repair workshop
- Instant ON/OFF capability
- Reduced environmental impact
- Heat sink means cooler and quieter running
- Flexible projection position

ROI team's evaluation over the second half of 2014 finds clear advantages for the Panasonic 6500 lm laser projector against the projectors most purchased by the higher education sectors:

- Brighter better projection:
  Cumulated Light Output **22% greater**
- Environmental stewardship:
  Carbon emission **reduced by 26%**
- Lifetime Cost of Ownership:
  More than **11% lower**

Lifetime power consumption

If we assume the effective operating lifetime of a modern projector to be 20,000 hours, then the lifetime power consumption is:

- Panasonic 6500 lm laser projector 9,621kW
- Conventional projectors 12,135kW

By this measure the Panasonic 6500 lm laser projector uses only 79% of the power consumed by a conventional projector of equivalent brightness, whilst producing 26% greater Cumulated Light Output across its lifetime.

Lifetime cost of ownership

Taking into account all costs associated with the purchase and effective operation of a projector we see again a clear advantage for the Panasonic 6500 lm laser projector compared with a range of most-purchased lamp-lit projectors:

- Panasonic 6500 lm laser projector €13,551
- Conventional projectors €15,259

Although the initial purchase price may be higher, lifetime freedom from maintenance and lamp changes gives the Panasonic 6500 lm laser projector a Lifetime Cost of Ownership 11% lower than a range of conventional projectors of equivalent brightness.

Lifetime carbon emissions

The lifetime comparison between the two projectors types shows:

- Panasonic 6500 lm laser projector 2.18 tonnes
- Conventional projectors 3.78 tonnes

Across its lifetime the Panasonic 6500 lm laser projector produces only 74% of the carbon emissions of a lamp-lit projector of equivalent brightness.

8. Evaluation of lifetime cost of ownership and environmental impact

Approach to the project

ROI Team's brief:
Benchmark the performance/ consumption of the Panasonic 6500 lm laser projector series of projectors against a range of historic lamp-lit projectors against the following fields:

- Lifetime Cost of Ownership – Financial Cost
- Lifetime Carbon Consumption – Environmental Impact

Market sectors

- Higher Education organisations: Universities, colleges, training schools etc.
- Museums and public access galleries
- Rental & Staging: performance and live events

Models for comparison: Solid Shine model: Panasonic 6500 lm laser projector versus a range of models identified by resellers and dealers across Europe as projectors in class 6,000 to 7,000 lm most purchased by the above three verticals.

Projector lifetime

Assumed to be 20,000 hours (equivalent to advertised maintenance-free lifetime of the Panasonic 6500 lm laser projector).

Usage pattern

Higher education organisations: 10 hours/day x 6 days/week x 45 weeks/year = 2,700 hours per year

Sources of performance metrics

i) Resellers/dealers independent of Panasonic, and actively selling into the Higher Education and/or Museums & Galleries sectors. ROI team survey made initial contact with 90 from 7 different territories. Information received from these sources was averaged.

ii) Manufacturers' published product data sheets.

iii) Aggregated Cost Calculator built for this project by Project Subject Expert, Dr. Joyce Tsoi with assistance from Ruby Sehmbi of ROI team.

Research Approach Work undertaken by project team from ROI team, London, UK (www.roiteam.co.uk), Project Director, Andrew McCall, with expert input from Subject Expert Dr. Joyce Tsoi.

Research approach and method adopted was scrutinised and endorsed in 2012 by UL (www.ul.com).

9. Appendices

Anatomy of calculators

Sector: Higher education – lifetime cost of ownership calculator

Actual Purchase Price

Operating Power Consumption (kW)
Standby Power Consumption (kW)
→ Power Consumption Cost

Lifetime Lamp Changes
Lamp Replacement Cost
→ Lifetime Cost Bulb replacement

Lifetime Maintenance Visits
Cost per Maintenance Visit
→ Lifetime Cost Maintenance Visits

Power Consumption Cost + Lifetime Cost Bulb replacement + Lifetime Cost Maintenance Visits → Lifetime Operating Cost

Lifetime Operating Cost + Lifetime Maintenance Cost → Lifetime Cost of Ownership

Carbon emission calculator

Operating Power Consumption (KW)
Standby Power Consumption (KW)
→ Total Electricity Consumption (KWh)
Carbon Conversion Factor
→ Carbon Emission (tonnes) (electricity consumption)

Maintenance Visits
(fuel consumption)
→ Fuel Consumption (litres)
Diesel Conversion Factor
→ Carbon Emission (tonnes) (fuel consumption)

Carbon Emission (tonnes) (electricity consumption) + Carbon Emission (tonnes) (fuel consumption) → Total Carbon Emission (tonnes)

Profile of ROI team

ROI team is a research consultancy that works to understand clients objectives, strategies, and challenges, devising and managing programmes of research to provide the hard evidence to enable well informed strategies and commercial decisions.

Clients include retailers such as Harrods, Flying Brands, and Best Direct; owners of retail property like Capital & Regional plc, Cadogan Estates, and Orion Land; the NHS and Department of Health and various regional health boards; and media companies such as Thomson Reuters, community TV operator The Life Channel, and publisher JLD Media.

Directors of ROI team have also led projects to benchmark performance of key products for leading companies such as 3M, JCDecaux, and Media Zest plc as well as Panasonic PSCEU.

In 2013 ROI team, in conjunction with counting company PFM Intelligence, launched the UK Markets Index, the first performance index for the UK retail markets sector. ROI team is currently developing its second index, the Retailers' Revival Index for launch in 2015.

ROI team is wholly owned by its founding directors and does not have any financial arrangements or obligations within its fields of operation. Our aim is to provide sound information, impartially interpreted,to provide a basis for informed business decisions.

ROI team (www.roiteam.co.uk) was founded in 2006 by Jo Johnson and Andrew McCall, who continues as Managing Director of the firm.

Dr. Joyce Tsoi is the Subject Expert for this project. Joyce has over 10 years of international experience in leading and managing sustainability projects in more than 15 countries, exploring strategic and pragmatic lines of progress in the areas of supply chain sustainability on behalf of leading international companies and governments. Her work has ranged from analysis of product and organizational life cycle, energy and climate change, sustainable water management, to reporting on sustainability and communication issues. Throughout her career, Joyce has conducted extensive research on Corporate Social Responsibility and sustainable supply chain management topics, and is a contributor to Journal of Business Ethics; Journal of Cleaner Production; and contributed a chapter to the book Corporate Social Responsibility.

Andrew McCall

Dr. Joyce Tsoi

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