LIGHT UP THE WORLD
RIGHT PERSON? RIGHT PLACE? RIGHT TIME?

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Dave Irvine-Halliday was an engineering professor at the University of Calgary, Alberta, Canada (see Exhibit 1). He spent his 1997 sabbatical in Nepal where he completed a project at the Institute of Engineering, Tribhuvan University, Kathmandu, Nepal. Then he embarked on a trek around the Annapurna Circuit, a popular trekking route in Nepal. During his trek, it became obvious to him that most rural villages lacked adequate lighting. He thought about the children's ability to read in their homes and schools. Dave concluded that there had to be some way to bring light to the villagers.

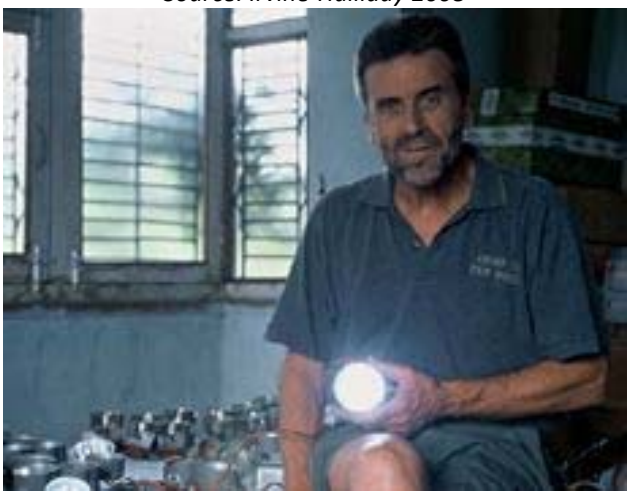
Upon returning to the University of Calgary, he plunged into what was referred to as *"a wee personally funded project"* which had little, if anything, to do with his 'real' research (Irvine-Halliday, Craine, Upadhyaya & Irvine-Halliday 2000). Toward the end of 1998, this project resulted in a prototype lighting system for the third world. In 1999, Dave and his wife Jenny took the prototype system to Nepal to determine whether Dave had developed a feasible, technological solution to the global third world lighting problem. The local response was overwhelmingly positive. Dave and Jenny were just 'blown away' by the villagers' excitement over the system.

Dave now had to decide whether to bring this technology to those living at the bottom of the pyramid. Should he start a social venture to light up the world? Was he the right person, in the right place, at the right time?

The authors developed the case for class discussion rather than to illustrate either effective or ineffective handling of the situation. The case and its accompanying instructor's manual were anonymously peer reviewed and accepted by the ***Journal of Case Research and Inquiry, Vol. 5, 2019***, a publication of the Western Casewriters Association. Contact: Sandra Malach, University of Calgary, 2500 University Dr. NW, Calgary, AB T2N 1N4, sandra.malach@haskayne.ucalgary.ca

Exhibit1. The Entrepreneur: Dave Irvine–Halliday

Source: Irvine-Halliday 2008



Dave Irvine-Halliday was born on May 29, 1942 in Perth, Scotland. He spent his childhood in Dundee, Scotland. His father was a machine man who operated lathes and drillers and his mother worked in a jute factory as a seamstress. His extended family members were workers at mills, shipyards and the local council. None were entrepreneurs or had a University education. He was poor, but not dirt poor. There was always food on the table and he never froze. He had one pair of shoes and, as a kid when he ripped the sole off playing soccer, he had to tie a string around it. The family didn't have a radio until Dave was in his teens – never mind a TV. However, Dave was educated and felt lucky that he was educated without paying a penny.

After completing high school in Dundee, he studied telecommunication engineering at the Abertay University. When he started University, he felt inferior to the other students and so he *"worked his backside off"* because he couldn't afford to fail. As the years went by, he realized he wasn't the cleverest nor the dumbest student. After completing master and doctorate degrees at the University of Aberdeen, he was ready to take a job in Switzerland. When he learned that immigration would not allow his wife, Jenny, and their 18-month-old daughter, Rachel, to join him for a year, he devised a unique solution. During his stay at a Swiss hostel, he had met some people from Edmonton. *"You fancy going to Canada?"* he asked Jenny. After a moment of silence, she agreed (Venter 2005).

Dave's start in Canada was difficult. The family lived in Ottawa for 3 months before Dave secured employment as an electrical engineer with Bell Northern Research. Four years later he moved to Edmonton to take a position with Alberta Government Telephones (now TELUS). At Alberta Government Telephones, Dave was first exposed to fiber optics. In 1980, the family moved to Scotland and then Australia, where Dave began his academic career at Victoria University of Technology in Melbourne. In 1983, he returned to Alberta when he was hired by the Faculty of Engineering at the University of Calgary. His specialty was fiber optics.
Dave had two grown children, a married daughter living in Vancouver and a son who was working on developmental projects around the world. His wife Jenny was a midwife by profession but had spent most of her time pursuing a variety of arts including weaving, spinning, and design. She was an entrepreneur, running a satisfying but financially unsuccessful clothing design business for 4-5 years.

Dave was fortunate as he always had a lot of physical energy. With a chuckle, he described himself as a recovering mountaineer and a mountain runner. As a student, he had been a Scottish champion cyclist who rode 400 miles per week. Mountaineering was close to his heart. As a young man, he climbed Ben Nevis, Britain's highest mountain, where he broke his leg, and Chamonix, where he broke his neck (Venter 2005). Calgary, Canada was only one hour from the Rocky Mountains – a great place to live for a mountaineer. He also traveled abroad trekking in Nepal and to Everest base camp.

Now, in his 60's he still had the capacity to work 18-hour days. When working on something he was passionate about, he never got tired. For example, the other night he talked on his cell phone until after midnight and when the battery ran out he called the party back on the land line to finish the call. He then did some e-mails and got up the next morning at 6 a.m. feeling refreshed. He didn't think he could work the same number of hours at a normal job (for which he lacked passion) but said that he felt blessed as being a professor gave him an amazing

amount of flexibility. He modestly said, *"I don't want to suggest that I'm a superman or anything like that but it's just a fact."*

Dave had always been a spiritual person who had a lot of empathy for those living in poverty. He attributed this to his upbringing in Scotland where he believed it was just a natural inclination to try and help people. Throughout his married life, his family always sponsored children from World Vision and other organizations. In this way, he'd always shown his concern for the developing world. In his 20's he started to think about things and made up his own mind. He wasn't concerned if others agreed with him, thinking, *"that's just too bad; I'm doing the best I can. I trust my own counsel."*

The Opportunity to Light up the World

Dave Irvine-Halliday was an engineering professor at the University of Calgary and spent his 1997 sabbatical in Nepal. Nepal was a third-world country located in the Himalayan Mountains bordered by India and China. Dave completed a project at the Institute of Engineering, Tribhuvan University, Katmandu, Nepal. He then embarked on a multi-day trek around the popular, mountainous Annapurna Circuit with his trekking guide, Babu Ram Rimal (Munday 2004).

Exhibit 2. Villages in Nepal

Source: Irvine-Halliday et al. 2000

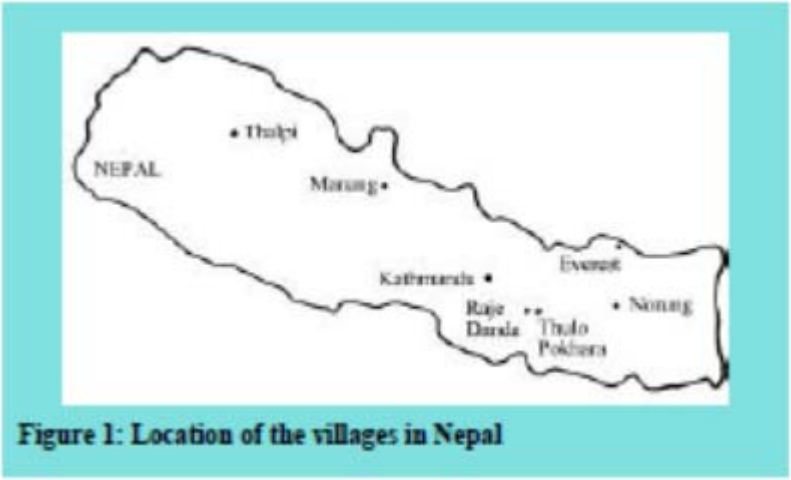


Figure 1: Location of the villages in Nepal

They spent one of the nights in the remote village of Manang and visited Babu's relatives (see Exhibit 2). Dave was introduced to a friendly couple who extended their hospitality to Dave and Babu by inviting them inside their stone and mud hut for tea. A wood fire that filled the air with smoke was used to heat the water. The home had no chimney as the Nepalese believed that the smoke from the cooking fire protected the wooden ceilings from insect attack (Irvine-Halliday et al. 2000). As Dave was sitting in this little home having a cup of tea with the old woman, he realized that he couldn't see the couple sitting in 5-6 feet in front of him until the embers would crumble in the little, tiny fire. Then he caught a brief glimpse of them.

On the trek a few days' later, Dave spotted a small, stone schoolhouse. His curiosity caused him to peek in the window. He was struck by how dark it was inside. In quick succession, two thoughts occurred to him– How do the kids see to read and write? Was there anything I could do?

Dave couldn't stop thinking about the lack of light in these villages that were off the power grid. The current light source was kerosene which was expensive, dangerous and provided poor quality light. The cost of operating a simple kerosene wick oil lamp was over 600% of that of a

lamp (as illustrated in Appendices A and B). Kerosene was also dangerous; it caused fires and burns, particularly to children, lung and eye disease and poisoning (Millls 2012). Dave compared the light of a simple wick kerosene lantern to that emitted by a birthday candle. A kerosene lantern provided only 1% to 10% of recommended lighting in industrialized countries (Mills 2005).

Dave thought that he could possibly come up with a novel solution to the problem. After all, he had a background in lighting and electronics. His knowledge of lighting included both traditional light sources, such as incandescent and fluorescent as well as modern sources, such as diodes and fiber optics. He understood traditional electrical grids as well as batteries and emerging solar technology. As a researcher in the field, Dave knew that a feasible solution had not been developed for poor people living in third world countries because over 2 billion people still didn't have a safe and affordable light source.

Upon his return to the University of Calgary, Dave set to work in his lab developing a lighting system for the third world. It had to be: simple, reliable and economic (Irvine-Halliday 2000). He tried to make white light with colored diodes. The results were disappointing – after 20 minutes you could barely see the light, much less read by it. However, he continued to work and developed a generator operated by pedals where power was generated when a person pedaled as if on a bicycle. The light source problem persisted until one day late in 1998 Dave conducted an internet search for "illumination products" and much to his wondering eyes did appear the words "White LED" on the web page of Nichia, a Japanese company (Munday 2004). He immediately called the company and explained that he was working on a project for the developing world and requested samples. Within a week, Dave received a shipment of a couple of dozen white LED diodes. Immediately, Dave, and his technician, John Shelley, took the samples to the lab. They connected the diodes to a power supply, placed a typed sheet of paper beside the diode, turned off the lights and turned on the diodes. Standing in front of the lighted

table, Dave exclaimed, *"Good God, John! A child could read by the light of a single diode!"* That was a defining moment (Irvine-Halliday 2007).

Dave worked excitedly to design the first lighting system. The technicians in the Department of Engineering developed the circuit layout and circuit boards. Some of the designs were a long strip of about 8 diodes, others were square, and others were round. Different configurations were developed to determine which would most effectively light space. Now that he had connected the lights to the pedal generated lighting system more questions gnawed within Dave. Would it work in Nepal? Would the villagers accept it?

Dave knew that he had to return to Nepal in 1999 – an expensive trip. He put it to his wife, Jenny, this way:

> *"Look, we're going there. We would have to pay for it ourselves because we couldn't get anyone to give us money to try this thing out. But there was a real chance that the people in the villages wouldn't like this. Just because we thought it's a great system doesn't mean they would think so. We had to make sure that we didn't set ourselves up for failure. If it was obvious that it was not good enough or the villagers didn't see its purpose, we had to accept that possibility. We'd have to be prepared to just come home and set up a little business. That plan was to start to make headlamps for mountaineers and other things*."(Irvine-Halliday 2007).

In May 1999, Dave and Jenny returned to Nepal to ascertain how the lighting system would work and see if it would be accepted by the villagers. One evening, at the beginning of their trip, they were having supper in a powerless guesthouse with a local villager. In this mountainous village, the sun had set, and a kerosene lantern was the sole source of light. Unbeknownst to the villager, Dave had strung a LED light system over the table and connected it to a charged battery. He asked his host to turn off the kerosene lantern. Then Dave switched on the LED lights. There were smiles all around the table. After enjoying their dinner, the villagers asked if they could keep the light (Munday 2004). Dave and Jenny demonstrated the light to many villagers in many villages – the response was overwhelming. The people pleaded

with them to leave the lamp – just one lamp. They hated kerosene – it was smelly, it was expensive, and it was dangerous. Dave and Jenny were blown away by the success of the lighting system.

Within a week or so of going to their first village, Dave noticed that people used flashlights powered by D-cell batteries and incandescent bulbs. He decided to conduct an experiment. He bought some flashlights, took out the incandescent bulbs and replaced them with LED's. In the experiment one flashlight had an incandescent bulb and another had LEDs. He turned off the light in the hotel and turned on the flashlights. No light meter was required to clearly see that better light was emitted from the LED flashlight. Also, the battery life would be increased by at least seven times in the LED flashlight. The bulbs would not break if the flashlight were dropped. Dave realized that a huge environmental impact could be made just by replacing the bulb (Irvine-Halliday et al. 2000).

The 1999 Nepal trip gave Dave evidence that his technology worked and that it was overwhelmingly accepted by the villagers. It also dawned on him and his wife that this project was bigger than anything they had ever imagined – it was much bigger than Nepal. Dave was still thinking of the technical things – developing and improving this system so the kids could read at night and so that they could do homework after working in the fields. Nokia was at the time the sole manufacturer of white LEDs, so it would be the sole supplier. How would the system's power be generated? The prototype utilized mechanical power but with the rapid gains being made in solar technology could the sun be a viable power source? Would each individual lighting system have its own generating source, or would there be a central village charging station? Dave also thought about the distribution and maintenance of the systems. Would the systems be assembled centrally or at the village? He was considering that some locations could only be accessed via trekking or narrow, dirt roads. Did installation and maintenance create a small business opportunity for a villager? How would they be trained? Most of these locations were not connected to the internet. Dave also considered some

business questions. What were the system component and manufacturing costs? Would they differ if Dave started a non-profit versus a for profit social venture? Should the systems be donated to the villagers or should they be purchased? What was the price? How would the villagers pay?

It was a gradual realization – "*my God, this is just huge!*" Dave and Jenny had to decide whether Dave should dedicate his life to bringing light to those living at the bottom of the pyramid. What should Dave do? Was he the right person? At the right time? In the right place?

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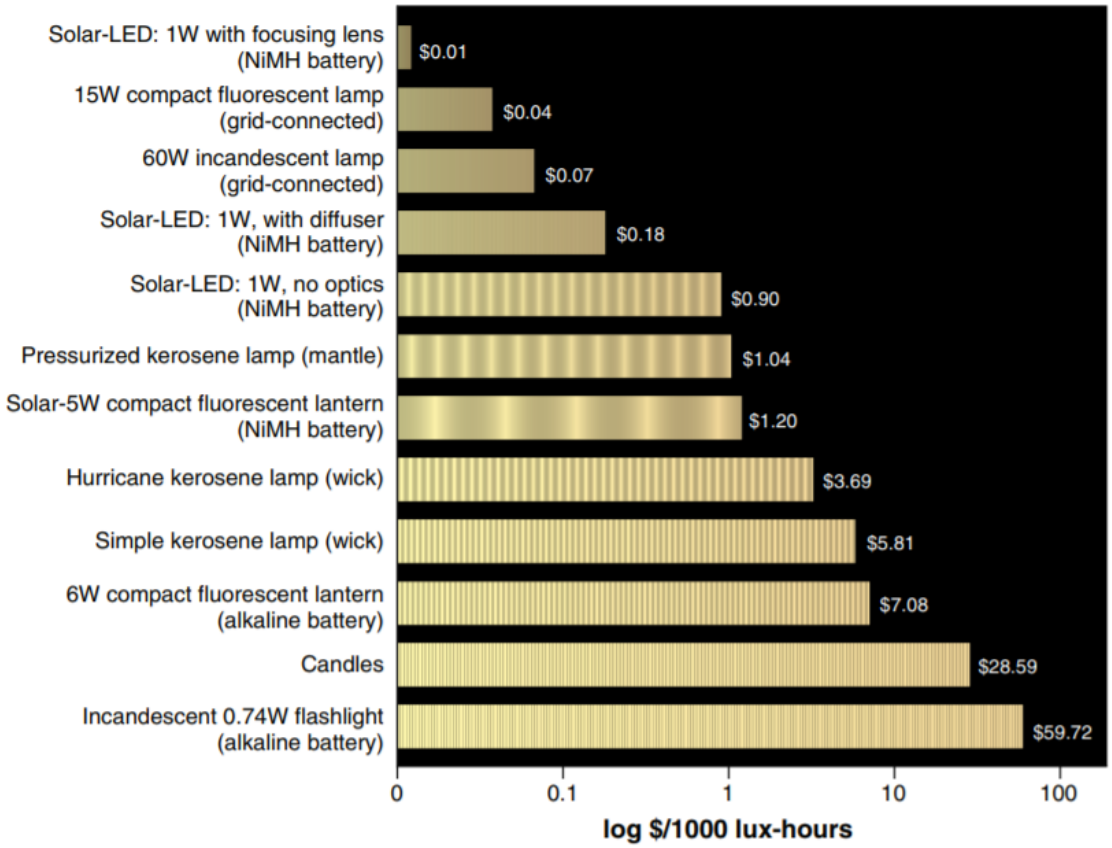
Appendix A
Total Cost of Illumination Services

Source: Mills 2012



Total cost of illumination services. Costs include equipment purchase price amortized over 3 years, fuel, electricity, wicks, mantles, replacement lamps, and batteries. Performance characteristics of light sources vary; values shown reflect common equipment configurations (see table S3) and include dirt depreciation factors for fuel lanterns and standard service depreciation factors for electric light per Illuminating Engineering Society of North America. Assumptions are 4 hours/day operation over a 1-year period in each case, $0.1/kWh electricity price, $0.5/liter fuel price. NiMH, nickel metal hydride. (Range of market prices for kerosene shown in table S5.) We estimate an average of 11 liters (*1*) of lighting fuel per household per month; oberved values vary from 2 to 20 liters (table S4).

Appendix B
White Led Lighting and Power Information

Source: Irvine-Halliday et al. 2000

Comparison Between an Incandescent Bulb and a WLED Lamp

Lamp Type	Input Voltage	Input Power	Cost (C$)	Relative Heat Output	Ruggedness	MTBF (Hrs)	Luminous Efficacy	Improvement Potential
Incandescent	110 V AC	25 W	1	Very high	Very low	1,000	10-20 lm/W	Very low
12 WLED	12 V DC	1 W	20	Extremely low	Extremely high	100,000	15-20 lm/W	Extremely high

Typical WLED Home Lamp Assemblies & Power Requirements

Fixture	Type	Application	Power
Flexible Table Lamps	3 WLED	Reading	0.22 W
Fixed type, box shaped	2 WLED	Torch	0.15 W
Ceiling Light	6 WLED	Main Room	0.43 W
Ceiling Light	9 WLED	Main Room	0.65 W

Approximate Calculations for Different Battery Costs in Nepali Rupees

Type of Lights	# of households	# of lamps per household	Power required per household	Cost of power for all households (NRs)	Battery Cost per household (NRs)
Bulbs	100	3	105 W	1,102,500	-
AC Compact Fluorescent	100	3	39 W	409,500	-
DC Fluorescent	100	3	27 W	283,500	4,821
DC WLED's	100	3	3 W	31,500	536

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