

TRAINING THE NEXT GENERATION OF ENGINEERS FOR PHOTON BASED LIGHT SOURCES

S.M.Scott, Diamond Light Source, OX11 0DE Didcot, UK

Abstract

The continued increase in the number of Light Sources, their beamlines and the need for upgrades of both machine and beamlines requires an increasing supply of suitably qualified and experienced engineers. If there is a world wide shortage of Engineers where will facilities find these engineers and how can they be trained to the required level? This paper discusses these issues by looking at the growth of demand for engineers within light sources, the evidence of shortages of engineers, the changes in attitudes to work by younger people, the skills necessary, training opportunities and the issues in attracting people into the light sources industry.

GROWTH OF LIGHT SOURCES

The first observation of radiation from accelerating electrons was in 1947. At first, synchrotron radiation was obtained from electron synchrotrons built for other purposes such as for high-energy physics. Dedicated machines started to appear in the 1970's and since then there has been a constant increase in the number of synchrotrons operating throughout the world. As well as an increasing number of facilities, the size and complexity of each synchrotron is increasing. The larger number of beamlines per facility, the demands for higher levels of stability, smaller beam sizes, higher power and faster throughput all require Engineers with a high level of expertise and experience.

IS THERE A WORLD SHORTAGE OF ENGINEERS ?

Some of the recent headlines would indicate a shortage of engineers in many parts of the world.

"By 2025, we might need 500,000 engineers, said Olof Persson, chief executive, of Volvo Group, the world's second-biggest truckmaker" [1].

"Peter Löscher, chief executive of Siemens, Europe's largest engineering group, said "the skills shortage, particularly in Germany, is a big issue" [1].

"Washington Post editorial published on August 4th 2011 warns of an approaching disaster in the shortage of professional engineers in the US."

As well as the media sound bites there are well researched reports.

"According to a recent Engineering labour market study by Engineers Canada, the country's rapid growth in the mining, energy, and transportation sectors, coupled by the anticipated retirement of approximately 95,000 Canadian engineers in the next 7 years, has resulted in a worrisome shortage of experienced engineering talent" [2].

The "skills panorama" are part of the European commission and monitor skills shortages. They report that across the EU, the top five skill shortage occupations include engineering professionals [3].

Within the UK, the Royal Academy of Engineering's report highlighted a shortage of Engineers within the UK across all sectors of the economy [4], the Institution of Engineering and Technology (IET) 2017 skills survey [5] concluded that engineering skills shortages and gaps continued to be a huge problem for employers.

In India, about 1.5 million engineers graduated from more than 3,500 engineering colleges across India in 2014. But at a recent meeting to discuss the Indian aerospace industry the conclusion was that only 4 to 7 per cent of engineers are actually fit for jobs in the core engineering sectors [6].

However one of the problems in developing a global view is the lack of reliable data. In a recent report by Emma Smith [7], she concludes that while the shortage debate has a long history, it is one that is characterized by poor quality data as well as methodological and conceptual challenges.

IS THERE A SHORTAGE OF ENGINEERS FOR LIGHT SOURCES?

If accessing a shortage of Engineers worldwide is difficult, can we say anything about the shortage within the light source community?

One way of examining the need would be to review the number of vacancies that exist. The vacancy pages of the web sites of each facility may give information as well as generic web sites such as www.lightsources.org. The problem with this approach is that the recruitment and supply of staff varies between facility and country. For example SOLEIL Light source have a limit in staff numbers as part of the legal structure and any shortfalls have to be met with contractors. In the USA, some beamlines are operated by university departments that are separate from

the overall facility organization, this makes it difficult to determine if there is a shortage within the light source community.

THE POSITION IN THE UK

In the UK, it is easy to state the position. The UK has one synchrotron and all its permanent staff are employed directly by the facility and this makes the vacancy position easy to measure. The position is that there is a very definite shortage of mechanical, electrical and controls engineers. The reasons may be very much due to local conditions including high demand from other local high technology companies, expensive housing costs as well as a national shortage especially for electrical engineers. The decision to leave the European Union has also not helped.

IMPROVING THE DATA

It would be an advantage to have more data from other countries. This could help in developing a strategy that could be adopted that could help all facilities tackle such a shortage if it really exists.

A STRATEGY TO ADDRESS SHORTAGE

Making the Light Source Community a Desirable Destination.

For anyone searching for a new job, a career at a Synchrotron is not likely to be high on the agenda. Within each country the number of people employed within light sources is dwarfed by that in other industries such as Automotive, Aerospace or Energy. To address this we need more people to be aware that such industries as ours exist and that we have a number of unique selling points over other industries. These could include the following;

- Much of the work done at light sources is aimed at helping mankind including the research into environmental issues and understanding disease.
- An industry where collaboration is of prime importance.
- Much of the engineering is state of the art at the forefront of technology.
- Usually function far outweighs issues of cost.
- The work is varied and interesting

One of the areas where light sources can be improved is their own web sites which can be dominated by the scientific output and not highlight the engineering which enables such ground breaking science to be performed. Social media is now the prime method of engagement and such avenues such as facebook, twitter, linkedin, Insta-gram, youtube, google+ and snapchat need to be used more effectively to tell some of the stories about developments at light sources and increase awareness.

Increase Recruitment of Graduates

Many industries have substantial graduate recruitment programmes and spend appropriate resources on recruitment and training. They therefore tend to attract the best graduates often well before their final year by offering sponsorship.

For light sources to become attractive to good graduates then the opportunities need to be highlighted or improved. One area that could be developed would be to provide opportunities for graduates to visit facilities in other countries. This could be short-term visits, training courses, or secondments. Highlighting the international nature of the community and location of facilities in some very attractive parts of the world could help with recruitment.

At Diamond there are close ties in the science community to universities but this has not been so for the engineering community. Recently Diamond Engineers have been developing closer ties to universities with strong Electrical Engineering departments. This has produced a number of advantages including the following:

- Highlighting career opportunities at Diamond
- Identifying potential projects for final year students
- Creating opportunities for Diamond staff to give guest lectures to demonstrate how skills and knowledge gained at university is applied in real life.
- Identifying where specialist facilities and equipment at universities could be used for solving problems at Diamond.

Improve Training Opportunities for Existing Staff

Training of existing staff is critical, not only to improve skills and knowledge but also to help with staff retention. For some facilities training can be an issue, with insufficient staff to provide the training or not having the required skills to deliver such training. Sharing of training resources would of potential benefit. Such resources could be online videos, webinars and manuals. Diamond are organising a training course for engineers who are early in their career at light sources. As well as providing some training in some of the basic issues regarding light sources it also provides a face to face opportunity to meet engineers from other light sources and help develop social networks.

Staff Sharing

With a number of facilities, undergoing upgrades then there are certain skills that are in high demand during these long shutdowns. This for example includes survey and alignment specialists. The additional staff required are only needed during the shutdown so could there be a

system established where suitable staff are available for loan from other facilities

Changing Attitudes to Work

There are changing attitudes to work. Previous generations may have expected to stay with one company for a good part of their working lives. Now there seems to be an assumption that younger people will have a much more fluid career with frequent changes of employment. This change means that there will be a much higher turnover of staff and so recruitment and training systems will have to be modified to reflect these changes.

A recent report on attitudes [8] reported that "Our respondents are imploring business leaders to take the lead in solving the world's problems, to shift organizations' motives from inordinately focusing on making profit to balancing social concerns, and to be more diverse, flexible, nurturing of and generous with its employees." This focus on solving the world's problems very much fits into the light source community and so if this could be highlighted than it would make a career in light sources attractive,

Increasing Diversity

In some areas, such as nationality Diamond are very diverse, but the percentage of female engineers in the UK is very low and although many countries the percentage is higher there is still more that can be done to attract girls into engineering. It is well known that female role models are very important so any efforts to increase visibility of women in engineering should be encouraged. In some fields efforts are made to ensure that there is a balanced representation in organising committees and speakers at conferences. This is a sensitive subject and there is no suggestion that women should be selected irrespective of their ability but given equivalent abilities a gender balance should be the long term aim.

TRAINING

Training has a key role to play not only in increasing skills level but also to help with staff retention. Training can comprise of not only technical skills but also the soft skills in communication and team work. With a potential higher level of turnover the demands of training increase and a cyclic training scheme needs to be established. At Diamond we are starting to establish in house training in such areas as motion control, EMC, vacuum technology. We have also identified a need to provide a basic grounding in the wider aspects of synchrotron Engineering so we are organising a week's course which is aimed at engineers early in their career at light sources. This is open to engineers from other light sources.

As well as recruiting experienced staff, fresh graduates and apprentices, Diamond are encouraging existing staff to upskill with day release to college.

Beamlines

End Stations

FUTURE ACTION

There are a number of actions that could be taken to address the possible skills gap within the light source community.

These could include the following:

- Sharing of information about skills shortages
- Greater visibility of Engineering on facility websites
- Development and sharing of training resources
- Sharing of staff by secondment between facilities
- Highlighting female engineers as role models
- Closer liaison with Universities

CONCLUSION

As the technology behind third generation synchrotron light sources and free electron lasers becomes evermore challenging the importance of having a good supply of skilled and experienced engineers has never become more critical.

Although there is some data indicating a world wide shortage of engineering skills there is no data to indicate a shortage within the light source community except in the UK.

If there is a shortage, there are a number of actions that could be taken. This includes opportunities for coordinated and shared training, increased publicity on the role of engineering and staff sharing. The author would like to further develop these ideas and welcome collaborations and discussions with staff in other organisations and facilities.

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