

PRODUCT DEVELOPMENT: AN ENGAGING CAREER FOR PHYSICISTS

BY JOHN WALMSLEY, P.PHYS.

Within a day of his birth, my first son had a routine hearing test. A volunteer balanced a heavy handheld device on the bassinet and used it to characterize the returned signal from an acoustic pulse sent into each ear in turn. My son passed the test. I was fascinated by the combination of physics and physiology involved but my most abiding memory is my concern that the heavy device was going to fall onto my son!

Product Development is the process that creates devices such as the hearing screener from market need to initial concept to final, polished, manufactured product. For the hearing screener to become a successful product, many elements needed to be right: the core algorithm had to work, a volunteer needed to find it easy to use accurately, the hospital system had to have been able to afford it and, of course, it can't hurt the kid being tested.

The Product Development team gets these elements right by identifying and solving a long series of problems that block the creation of the device. What's more, the problems need to be understood and solved well enough to enable a manufacturing team to make thousands of devices. Finally, putting those thousands of devices in the hands of users, in my mind, maximizes the value of the solution.

The people working in these Product Development teams are often engineers but my purpose in writing this article is to point out that Product Development offers an interesting and engaging career for physicists.

My perspective on this is informed by the job that I do. I am a physicist and the company that I work for, StarFish

Medical (Fig. 1), employs over 40 engineers and physicists in Victoria, BC.

Of those, 20% are graduates that we have hired in the last two years. StarFish Medical is a product development consultancy focused on creating innovative medical devices for clients and then readying those devices for market. Mostly the devices involve different types of electrical and mechanical systems working together and controlled by software. We have worked on disparate devices: some as complex as haemodialysis and ultrasound machines, some as simple as syringes and some as virtual as apps in the App Store. We have, by coincidence, also helped develop the next generation of that hearing screener – we took the opportunity to give it a hook to keep it safely attached to the bassinet.

Our company was founded and is still led by an Engineering Physicist and we employ physicists who do software, electronic and mechanical design. We also look to physicists to fulfill the roles of project manager and systems engineer. In other product companies where I've worked, physicists have been sales people, marketing managers, financial comptrollers and general managers responsible for operations. Companies who have hired StarFish also employ physicists in similar roles. Several have physicists as CEOs. In each case, the physicists have been able to rely on their ability to understand complex technical situations quickly and efficiently.

Physicists bring a training that encourages us to see the whole problem, conceptualize it and then simplify it in ways that allow the problem to be solved more straightforwardly. We have a facility for recognizing patterns at a range of scales and using the scientific method to confirm that we are on the correct path. We don't mind exploring boundary conditions, reversing the timeline, making order of magnitude estimates and performing controlled experiments to work our way through a new situation. Finally, our degree gives us a context for understanding most technologies, even if we haven't met the specifics before. All of these skills give physicists an advantage in the work of Product Development where, as I've said, there are many unknown problems to be discovered, defined and resolved.



SUMMARY

Product Development provides a lifelong career with opportunities to apply physics and physics thinking. I describe one career and offer hints on getting a job in the field.

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Fig. 1 Starfish Medical working environment.

WHAT CAN A CAREER LOOK LIKE?

My personal path to being responsible for the Starfish Medical team who do this work started with a physics degree at the University of Bristol in the United Kingdom. I was an undergraduate there during the late 1980s and, at the time, the most obvious paths for a Bristol physics graduate were either a PhD in particle physics or, in contrast, a job with one of the large London-based management consultants. When I started my degree, I chose physics because it interested me and I assumed that I would progress to a PhD in some specific area that excited me. As I worked towards completing my degree, it became clear to me that obtaining a PhD was not what I wanted to do. I also did not want to join the ranks of management consultants. I discovered through career advertisements that I could combine my interest in gadgets with my physics degree by becoming part of a team that brought products to market. I started applying for such jobs. Unfortu-

nately, this was at the start of a recession and none of the companies that I spoke to were hiring people who didn't have any direct work experience.

My pragmatic solution was to do an MSc in a field that interested me but that, importantly, would give me practical work experience in an area that seemed about to boom: fibre-optics. My MSc taught me the fundamentals of opto-electronics and gave me hands-on time with lasers in the lab. Perhaps even more importantly, the MSc gave me the chance to do an internship at the leading industrial research centre in the field, British Telecom's Research Labs. When the time came to apply for work in the field of fibre-optics, it made a big difference to hiring managers that I had already demonstrated an interest in this area and that they could talk to my internship supervisor and hear from him that I could quickly become a productive member of their team.

My first professional job title was Development Engineer with a company called BT&D Technologies (a joint venture of British Telecom and Dupont). My very first task was to characterize some new long-haul communication transmission semiconductor lasers. These Distributed FeedBack (DFB) lasers had two inherent modes of operation that could cause a ‘kink’ in the output characteristic and we couldn’t ship lasers where that happened. My MSc meant that I was already aware of this property and suited to make the measurements. Quickly, it made sense to automate the testing and because I had been programming since I was a young teenager, I was glad to look after this. As time passed, I was given responsibility for a small but important side-project. Here I learned the skills of customer management, production coordination, and project management. During any week, I could be solving problems related to the intermetallics in non-eutectic solders, crack propagation in glass fibres, optimization of software to speed up test times and talking a customer through a tricky production delay. Clearly, I needed to rely on experienced colleagues to get up to speed in many of my tasks, but I found that the general grounding I had acquired from my undergraduate physics training provided me with a context for all of it, and I never felt lost.

On my first day at BT&D, the company had announced the commercial availability of the first Erbium Doped Fibre Amplifier. This was the final technological piece to enable the full capability of fibre-optics and marked the beginning of a decade-long fibre-optics boom, powering the expansion of the Internet and the welcome collapse in long distance phone rates. It was a thrill to be doing my part to make the world a smaller place.

During that boom, I moved to Canada, relying on my fibre-optic expertise to get a job doing similar work here in Victoria. (By the way, all long-haul amplifiers are still powered using a fibre-Bragg-grating stabilization method invented and commercialized by a physicist based here in Victoria.) When the boom came to its sudden end, I moved to the Bay Area of California and spent a further two years doing a similar job before coming back to Victoria and StarFish Medical.

It was my expertise in project management and the introduction of new products to manufacturing that got me the job in medical device production with StarFish. At the time, I knew little about medical devices themselves but my fundamental understanding of physics gave me the head start I needed to get up to speed quickly in a wide range of medical technologies.

HIRING CRITERIA

Now, as VP of Product Development with StarFish Medical, I find myself in a position where I look to hire bright, enthusiastic graduates who can quickly be productive for the company and our clients. At StarFish, we look, first of all, for candidates who want to develop products and are willing to push forward to solutions that will support the completion of

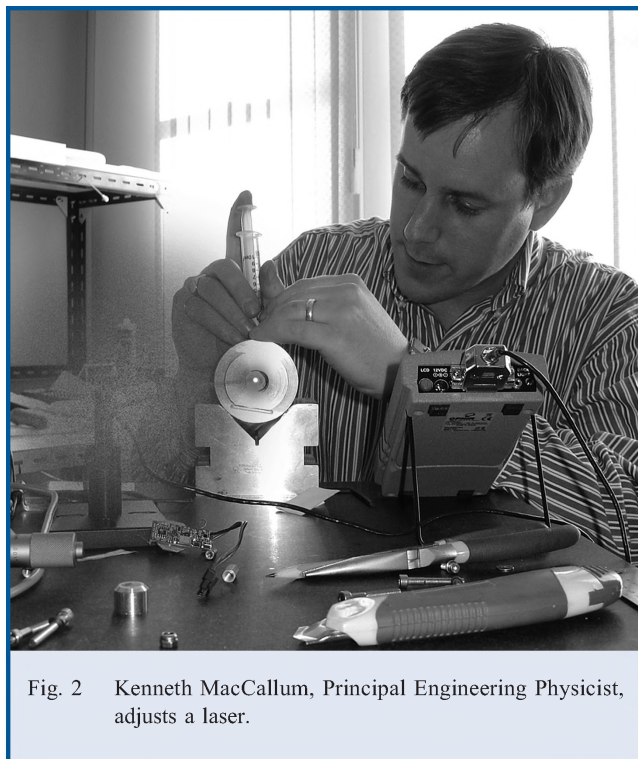


Fig. 2 Kenneth MacCallum, Principal Engineering Physicist, adjusts a laser.

product designs. We also look for individuals with a demonstrable capacity in a skill that we need so that we can have confidence that they will be productive in some way right from the start. Our recent graduates are currently contributing to a range of interesting and challenging projects (Fig. 2), including: optics systems for cancer margin assessment and to control infection in hospitals; mechanical systems to control the injection of therapeutic stem cells; ultrasound systems for imaging of the body both generally and within the heart; microprocessor C programming for a variety of applications from motor control to data capture; 3D imaging representation systems; and user interface creation.

With experience, some new recruits will specialize in algorithm development, coding, circuit design or fluid mechanics. Others will take a path where they use their general knowledge to tie systems together, managing the interactions and risks as the various components are integrated into a device. Others will manage project teams so that the product is developed and ready to launch within the client’s budget and timelines.

SO YOU THINK YOU WANT A CAREER IN PRODUCT DEVELOPMENT?

During an interview, a hiring manager is looking for evidence that you will enjoy and be successful in the work of the job that you are applying for. Good managers will understand that a new graduate needs support as they build their skills and experience in the early stages of their career. Given a choice of candidates, however, they will prefer someone who has already

pulled together their knowledge and experience to achieve something because they will probably be able to do it again.

The best evidence for this manager is a hands-on project that you have completed on your own initiative, whether by yourself, with your local maker club, or with friends. Many physicists find that programming is an accessible skill. Using low-cost platforms such as the Arduino or Raspberry Pi, you can build useful skills while demonstrating a real interest in technology by creating an interesting and challenging demonstration project.

Of course, an excellent way to build a portfolio of interesting work is to take full advantage of the co-op program at your institution. To get the best effect, you should work with the coordinators to identify good opportunities that match your interests or let you test the depths of those interests. Don't limit yourself to companies that have already connected with the

co-op program. Reach out to managers at companies that align with your interests and find out if there are options to spend time there. When you are on site with the co-op company, ask to be exposed to diverse opportunities - and don't forget to complete something useful while you are there.

CONCLUSION

Product development represents an opportunity to make a real difference in the world. The possibilities for physicists in product development are many and varied. I've illustrated just a sampling of those with reference to my own career and the work of my current employer, StarFish Medical. There are many other similar opportunities for physicists in Canada. The specialisms and the paths to them are wide-ranging. With attention to gaining and maintaining relevant experience and skills, it is possible to have a rewarding, long career in product development.