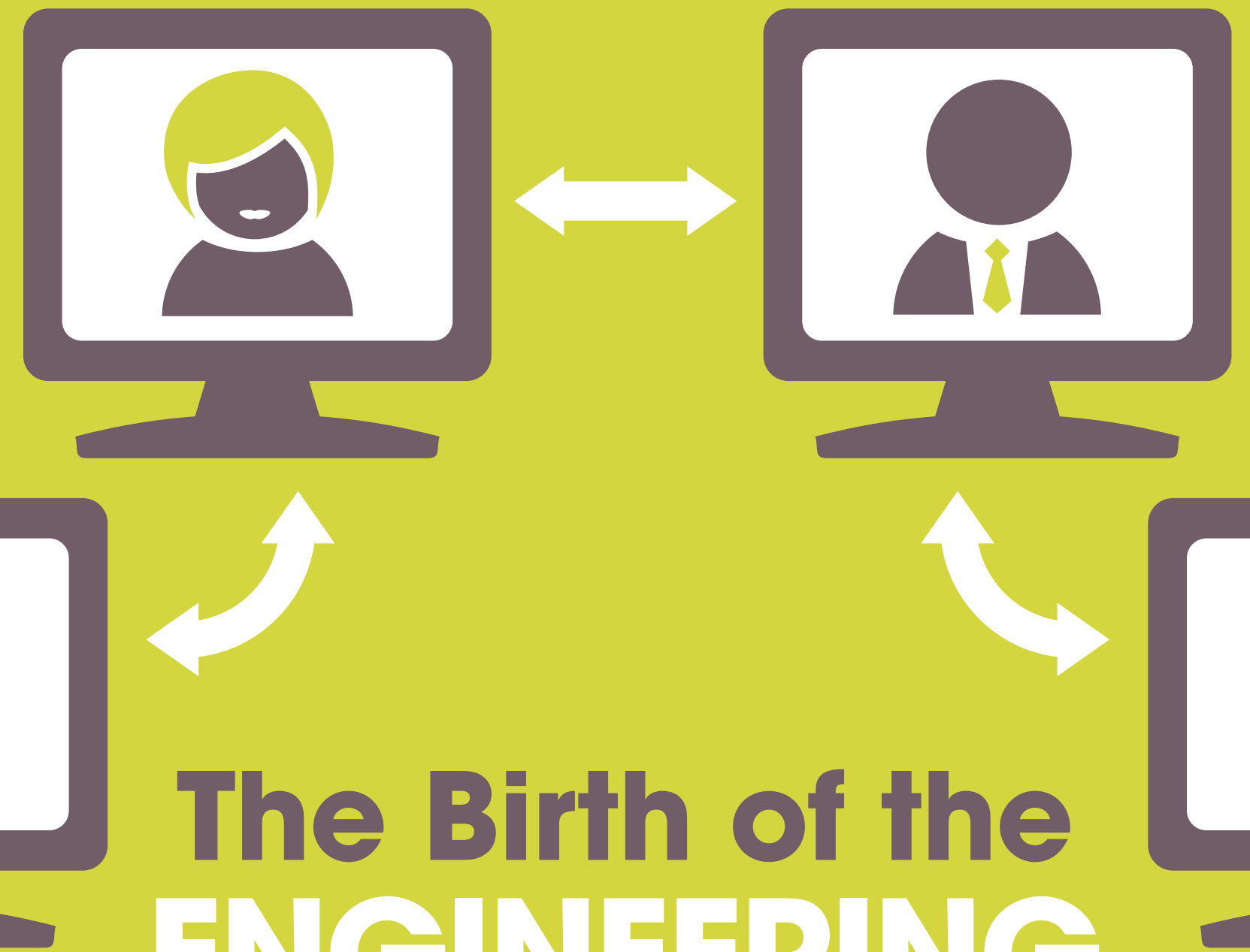

The Birth of the ENGINEERING RENAISSANCE

By Andrew Back, co-founder, Solderpad

Developments in recent years suggest that we may be on the cusp of an engineering renaissance. Significant advances are being made in key areas such as tools, technology, principles and methodologies, and at the nexus of which is an ever growing desire and ability to engage in engineering practices.

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Individual developments in and of themselves may appear far from profound and in many cases it would be easy to trivialise these else simply regard them as temporal phenomena. However, when viewed as a part of a much larger shift their vitally important role and combined effect becomes apparent.

A period that spanned the nineteenth and early twentieth century can be seen as having given birth to many current engineering practices. Then, early innovation across technical disciplines frequently took place at a grassroots level and was often fuelled by an individual's desire to understand, experiment and invent. Recent developments are lowering the barriers to engaging in engineering practices and are fostering far-reaching social participation, and once again the amateur is playing a pivotal role.

Sustainable Communities

Some of the earliest adopters of new technology are intrepid non-experts that possess a do-it-yourself ethic, and as the level of interest has grown user groups and publications have sprung up to serve the needs of these nascent communities of interest. Examples of this have included amateur radio societies and magazines, home computing and tape recording clubs*. Whilst to a greater or lesser degree these have provided the support of a network and opportunities to share knowledge, their modes of communication were frequently broadcast (one-to-many) in nature and high latency, and the network limited in terms of discovery, growth, speed and potential.

The advent of the widespread availability of Internet access and beyond this the Social Web and tools for online collaboration, has served to accelerate the development of technical communities. Where previously a niche interest may have proved unable to sustain a community due to the relatively small number of actors involved and their geographic dispersion, such factors have largely been mitigated via online tools. From e-mail and mailing lists, through wikis and social networks, to electronic design tools and version control systems; much is now possible that not very long ago represented a major challenge and search/discovery, connectedness and instant many-to-many communications are now taken for granted.

Whilst online collaboration may be seen to have supplanted geographically organised groups this is not the case, and indeed it has given birth to many such groups and provided a medium for the transmission of patterns for collaboration that are centred upon a physical location. A canonical example of this being the recent proliferation of hackspaces – also known as hackerspaces, hacklabs or makerspaces. Typically autonomous in nature, these serve to provide a physical space where people with a shared interest in electronics, computing, science, art and much more can meet, share ideas and collaborate. The growth of which is perhaps not wholly dependent upon online tools, but these have clearly served to expedite both their development and proliferation.

> **"Thanks to online collaboration and unprecedented levels of connectedness there continues to be an exponential growth in innovation taking place amongst grassroots technical communities."**

The engineering social landscape today is almost unrecognisable when compared with the period spanning the birth of many current engineering practices and the advent of online collaboration. Related advances in recent years have spawned an explosive growth in engineering communities that are not only extremely diverse in nature but, importantly, increasingly inclusive. The significant positive effects of which may already be observed and we are only at the beginning of this journey.

Tools play a critical part in engineering and a lack of access to them can present a formidable barrier to entry. However, recent developments in low cost technologies and services for prototyping and manufacturing are helping to lower this barrier. For example, 3D printers

and laser cutters/engravers are now available in desktop configurations and are within the reach of the individual, and there has been a significant growth in services supporting PCB and hardware prototyping and small-scale manufacturing efforts, e.g. the Ponoko 'making system'*. The design artefacts for these more often than not lend themselves to collaborative development and are increasingly the product of a culture of sharing. Meanwhile, workshop tooling and electronic test equipment continues to become more affordable and community efforts ever more inventive, e.g. the RepRap self-replicating 3D printer* and the Pay It Forward printing initiative*.

This is not only good news for the individual and smaller enterprises but also for shared facilities such as hackspaces, which are subsequently able to better support a broad spectrum of creative practices with only modest funds. Whilst the spread of hackspaces means that the curious and new to engineering or those with limited resources are, with minimal commitment, able to gain access to tools and support in their use.

The Future is Open

The same principles that underpin the success of the Web and open source software are now driving a wider engineering paradigm shift; open collaboration, liberal licensing and empirical standards are enabling participation in the development of hardware, and the creation of novel approaches to many problems that were previously considered intractable for technical or economic reasons.

Whilst at first it might be difficult to imagine how methods employed in the development of open source software may be applied in support of the development of hardware, the last few years have given birth to countless projects which have gone on to demonstrate that the development processes are not so dissimilar. Noteworthy open source hardware (OSHW) projects include the aforementioned RepRap 3D printer, the Arduino microcontroller platform* and the crowd-funded USB protocol analyser, OpenVizsla*.

With open source hardware come new challenges, such as how to ensure the freedom of a design in perpetuity - as can be effected via the "copyleft" mechanism* with open source software - and how to enable online collaboration around design artefacts that take pictorial form rather than code. However, it is still relatively early days for OSHW when compared to the more mature open source software paradigm, and such issues will be addressed in due course.

The Role of Industry

Industry has a vital role to play in these developments and there are significant opportunities for grassroots communities and established commercial organisations to work together. Both in support of common goals such as fostering learning and the development of new technology, and in the creation of new jobs and market opportunities. However, organisations will typically need to look beyond familiar customer bases and sources of innovation to form these relationships, and it may prove useful to consider communities in a similar light to engineering schools and hackspaces to technology incubators.

As with commercial software solutions, it is not the case that commercial hardware must be assembled exclusively from either open or closed technologies and not a mixture of the two. OSHW can be combined with proprietary technology, subject to being able to comply with licensing conditions. Thus the OSHW opportunity is not limited to simply new and/or entirely "open" products, and indeed it is a great deal larger than this. For example, a group of manufacturers may choose to collaborate on the development of open source technology that is common to all their products but that is not their core business. Analogous to competing database vendors all contributing to the Linux kernel, this could be designs for e.g. safety controls, power supplies or interfacing. It is important to note that this is not the same as providing specifications alone or a restricted use reference design, and organisations that stand to gain the most from the OSHW development paradigm are those that participate with intent that is clear, honest and aligned with community principles.

Conclusion

Thanks to online collaboration and unprecedented levels of connectedness there continues to be an exponential growth in innovation taking place amongst grassroots technical communities. Recent advances in principles and methodologies, tools and technology are democratising the hardware development process, whilst fostering a growing interest in engineering practices and creating new market opportunities.
Whether you're new to the field or a veteran, and a hobbyist, at a start-up or with a long established organisation, this is an immensely exciting time to be involved in engineering as a dizzying spectrum of new possibilities opens up.

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