Free Technology Academy: Towards sustainable production of free educational materials

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Abstract

The decision to publish educational materials openly and under free licenses brings up the challenge of doing it in a sustainable way. Some lessons can be learned from the business models for production, maintenance and distribution of Free and Open Source Software. The Free Technology Academy (FTA) has taken on these challenges and has implemented some of these models. We briefly review the FTA educational programme, methodologies and organisation, and see to which extent these models are proving successful in the case of the FTA.

Keywords

Free Software, Open Source, OER, business models, education

Introduction

In recent years, many educational institutions, in particular those which receive significant public funds, have developed strategies to facilitate the transfer of knowledge from the institutions to the rest of society. One of these strategies is the production of Open Educational Resources, i.e., learning materials -textbooks, class notes, learning activities, etc.- which can be used, modified and redistributed by anyone with few restrictions.

The decision to publish educational materials as Open Educational Resources is usually supported by one or more of these arguments: because it is an efficient way to disseminate these works; due to an ethical imperative to publish educational materials without proprietary constraints; or because of a governmental policy that requires them to do so. In the case of the Free Technology Academy, this decision was taken very early in the creation of the project, and the main reasons were twofold: the ethical imperative of facilitating universal access to knowledge and for consistency with an educational programme about Free Software.

That decision taken, the question arises of how it can be done in a sustainable way. One may think that no revenue can be generated with free (as in freedom) materials. On the other hand, considerable resources must be invested to author, coordinate, publish, update and distribute course materials. In this article, we discuss some of the models for the production of course books, their publication and distribution and the running of courses based on these materials. We show some business models from the domain of Free Software, which has demonstrated over the last decades the evolution of many sustainable initiatives. Some of those lessons may be valuable for the domain of open education as well.

Finally, we discuss the particular choices of the Free Technology Academy and see how some of these models are being applied. In particular, we identify four important challenges to open education: providing tools to enable feedback and updates, choosing document formats to facilitate authoring and distribution, designing economically efficient practices for open development of course materials and the quality assessment of volunteer translators.

Economic models around free educational materials

FLOSSmetrics [1], an EC funded research project about the economic models behind 451 Free Software projects, mapped these projects along three axis: control (software model), collaboration (development model) and revenue (business model). The software model axis runs from proprietary to Free Software. The development model axis runs from closed to open to participation, and is not directly related to the software model: there is proprietary software which encourages active participation in the development (like SAP), while some Free Software projects are developed by one developer without any external participation. The third axis contains the business models: the way software projects generate income. Various business models are defined, which can be summarised into these main categories:

•*fully Free Software*, revenue is generated with training, custom development, consultancy, certification and other *services*

•business models based on proprietary add-ons, known as *open core* (like SugarCRM) or on publishing software both under a proprietary license and a free license, known as *dual licensing* (like MySQL)

•*platform providers* which generate revenue by aggregating applications into one coherent platform and certifying its quality (like some GNU/Linux distributors such as RedHat or Novell)

From the projects analysed and models described by the FLOSSmetrics research, we can conclude that service provision is the dominant way to generate revenues from software. In education, the analogue to fully free software would be 'fully free knowledge' - where knowledge is understood as explicit expressions of culture, technology, research. If we think of services in the educational domain, the most typical ones would be: tuition and guidance of learners in a course, assessment of learner's participation and assignments, certification of the acquired knowledge. The main ways of generating direct revenue with course books are as commissioned production of materials, and through a service to distribute printed copies, i.e. Print on Demand. Other forms of revenue can be generated by organising special events for specific target groups, like master classes for people in management positions.

In addition to the above, forms of "open core" exist in education. In MIT's OpenCourseWare, some parts of the courses are published under free licenses, while enrolment is required to access the full course contents. The model of "platform providers" can also be observed in some form in the open educational community. A university or network of universities offering a coherent educational programme could be seen as a platform provider, where the organisation invests in bringing a coherent programme with assured quality and certification and formal recognition of obtained results. This is very different from informal education, be it self learning or an informally organised course with no direct recognition and no guarantee to fit into a larger educational programme.

Production of materials

One interesting business model analysed in the FLOSSmetrics research is the *R&D Cost sharing* model. This is defined as cooperation between interested parties to achieve economic efficiency in the R&D of new software. It is observed that this model works best in a community when all participants have equal rights. Free licenses, open standards and open development practices can assure such a level playing field.

Regarding the development of educational materials, we find a wide range of models, from open to closed development. Benkler [2] analyses the differences between intra-firm, market based and peer production. He uses economic theory to show that, in certain cases, peer production can be more economically efficient than market-based or intra-firm production. Important reasons for that to occur are 1) the lack of transaction costs (no contracts need to be managed, there is almost no hierarchy), 2) motives other than monetary may induce people to participate in the production process, and 3) the results of the collaborative effort are available for all participants under equal conditions. The following options for developing course materials are thus available:

- internal production (intra-firm or intra-university)

- hire external experts (market based)

- peer production (non-monetary, social production between peers)

The *shared R&D* costs-model can be a combination of these three forms of production through cooperation between partner organisations and peers.

From the area of course design, a hybrid model is suggested by De Paula et al. [3]. In the Courses as Seeds model, an initial course material is **S**eeded at the beginning of a course, which is **E**nhanced in the educational process and the enhanced version is **R**eseeded before or at the start of the next edition of the course. Therefore, this model is also known as the SER-model. It is conceived as a meta layer based in Fischer's Meta-design conceptual framework [4].

This model could build on any of the earlier mentioned economic production models and facilitate the maintenance of educational materials via a peer-to-peer process, eventually complemented by paid staff for editorial and quality assurance tasks.

Realisation of courses

The realisation of courses is an activity whhich can take place in various ways. Here, we mention here educational models in combination with two revenue models: face-to-face or distance learning and paid enrolment or free of charge.

1. face2face, paid enrolment is most typical in courses that are publicly funded or that require tuition fees

2. face2face, free of charge occurs mostly in informal education, e.g. in DIY workshops at hacklabs

3. online, paid enrolment is used by most distance universities

4. online, free of charge, is practised for online courses by many peer to peer and self-learner communities with volunteer mentors, such as the P2P University

Setting up and running an educational programme with qualified tutors and formal recognition by universities implies not-negligible operating costs. When such operating costs need to be recovered through tuition fees, a sufficiently large group of learners should be attracted in order to reach sustainability. A critical mass of learners is not always present in the physical area surrounding the place where a face2face course is organised. Though further research would be needed, earlier course plans and study programmes in the area of Free Software suggest that a distance learning approach may prove economically feasible earlier than a local face2face course programme. In fact, the UOC's master programme in Free Software has proven to be very successful precisely because of being a distance learning programme.

FTA master level programme in Free Software

The following sections give a general view of the FTA programme and methodology.

Free Software Curriculum

Although some local initiatives of Master programmes in Free Software exist, such as the programmes offered by the UOC [5] and the URJC [6] in Spain, there is not an international joint or multiple-degree master programme that is offered in cooperation by different international higher education (HE) institutions. The FTA project is a European initiative to provide the necessary foundations for the creation of such international programme by running a virtual campus offering courses on Free Software and Open Standards to an international audience.

The FTA Campus provides a set of distance learning courses or modules complying with the Shareable Content Object Reference Model (SCORM) [7] standard, enabling the exchange of course content with other educational platforms. The materials, worked on by the members of the FTA consortium and the FTA associate partners (UOC, OUNL and URJC among others), constitute a part of their continued commitment to master programmes either specifically devoted to Free Software or more general (such as software engineering programmes) but with some particular subjects focused on Free Software.

One of the issues with has been tackled by the FTA project is the development of new conversion tools in order to be able to produce contents in the SCORM standard. Although SCORM content can be produced using some specific applications, such as the SELF platform [8], RELOAD [9]or Atutor [10], this would imply a manual process of copying and pasting from other formats (such as HTML or ODF). The production of SCORM versions of the materials can be accelerated with the development of particular conversion tools. Initially, the materials that have been published by the FTA were produced using XML with a structure defined by the publishing and technology departments of the Universitat Oberta de Catalunya (UOC-XML). This XML format has a particular XML Schema Definition (XSD) available to everyone willing to produce (or modify) materials in this format. As a first step, we developed a software conversion tool to generate a SCORM 1.4 version of the materials from the UOC-XML. This way, the SCORM version of the materials can be integrated in the FTA Campus using the Moodle functionality to play SCORM. In addition, the UOC Technology Department had developed another conversion tool which makes it possible to generate a PDF version of the materials.

The only problem with these conversion tools is that the XML-UOC format, though completely specified in an XSD file, cannot be directly produced with word processing applications (such as OpenOffice.org or AbiWord). Hence, although source XML-UOC files are available for the materials, it would be quite difficult for external contributors to produce XML files which can be converted to PDF or SCORM using the existing tools. Because of this, we have also developed a new conversion tool to produce the XML-UOC format from the standard DocBook format. DocBook has three approved OASIS [11] standards and some of them can be created using common word processors, such as OpenOffice.org (with a limited set of tags) or specific authoring tools [12] . The tool developed for this task allows a bidirectional conversion between the XML-UOC and DocBook formats.

All educational materials used in the FTA are Open Educational Resources and are being published under free licenses such as the GNU Free Documentation License (GFDL) [13] or the Creative Commons Attribution-Share Alike (CC-BY-SA) license [14], which allow them to be used, modified and distributed without any restriction.

The FTA educational modules are focused on Free Software and Open Standards. More specifically, eight educational modules have been developed for the programme offered by the FTA in 2010, whereas new modules will be offered in the 2011 edition. The first eight educational modules developed by the FTA consortium are the following:

•Module 1: Concepts of Free Software and Open Standards

•Module 2: GNU/Linux Advanced administration

•Module 3: Network technologies

•Module 4: Web applications development

•Module 5: Economic aspects and business models of Free Software

•Module 6: Legal aspects of the Information Society

•Module 7: Software development

•Module 8: Deployment of Free Software systems and case studies

Materials for modules 1 and 2 were already available in the UOC Master programme in Free Software (MFS). These materials were available in English and ported to the SCORM format on the SELF Platform, and were incorporated in the FTA campus after the necessary updating. For example, a new chapter on Open Standards was written for module 1. Materials for modules 4 and 7 were already available in the MFS in Spanish and Catalan and were translated into English after the necessary updating and adaptations. Materials for modules 3, 5, 6 and 8 have been built during this project. In some cases, some chapters have been taken from previously existing materials (after translations and/or updates). For module 8 different case studies about Free Software implementations in industry, education and government have been collected. All these courses are designed following the principles of the European Higher Education Area (EHEA) and consist of 5 ECTS (meaning 125 hours of student work) each. The tables of contents and competences of the different modules are published at the FTA website [15].

Apart from these eight modules, the 2011 edition of the FTA will include some additional ones to cover other issues in the field of Free Software. The new modules developed for the 2011 edition are the following:

•Module 9: GNU/Linux User Level

•Module 10: Free Software utilities and tools

•Module 11: Software Architecture

•Module 12: Assessment of Free software projects (Quality Metrics)

•Module 13: Free software in public administrations

•Module 14: Software Engineering in Free Software environments

As already remarked, the objective of the FTA is not to provide official diplomas. The FTA is not a HE institution itself, but a consortium of different HE institutions and associate partners. In order to get official recognition of the FTA modules, the learners can enrol in any of the different master programmes of the consortium in order to get the credits taken in the FTA recognised in those master programmes. This way, a FTA learner can finally achieve a Master Degree offered by one of the FTA consortium or associate partners.

The ultimate goal of the FTA project is to become a complete international master programme in Free Software offered jointly by the consortium or associate partners, either in the form of a multiple degree (several diplomas issued) or a joint degree (one diploma issued by two or more institutions). To achieve this goal, the FTA project has started the International Master Programme in Free Software (IMP-FS) taskforce participated by the consortium and associate HE partners. Due to legal constraints (law differences among EU countries), the possibility of a joint IMP-FS satisfying the legislations of the different involved countries may be quite difficult. For example, some countries establish master programmes with 120 ECTS whereas others favour 60 or 90 ECTS curricula. In any case, the first steps have been carried out to develop a joint offer which can, at least, lead to a multiple degree implementation of the IMP-FS in a near feature, with core courses shared by different HE partners and some specific courses particular to one or a few partners.

Educational methodology and course design

The FTA learning methodology allows learners to define their own study schedule: the main communication tools are asynchronous, there are few deadlines during the course and activities can be joined at different dates and times. This flexible model allows for anyone to join FTA courses, regardless of their location and job, as long as they have regular access to the Internet.

During the course, tutors use the class forums to engage learners in discussions and debates on specific issues related to the course's content. Also, several activities are proposed to help learners extend their understanding of these topics. For example, relevant experts are be invited to participate in the course as guest lecturers, giving a video talk and discussing it with the class afterwards.

The evaluation of FTA learners is done continuously during the whole course. There are a number of assignments that are be published during the course, for which learners receive marks: the Continuous Assessment Activities (CAA). Depending on the course these activities may consist of answering a set of questions, writing a short essay or completing and documenting a practical task.

Also, the participation of each learner in class activities such as debates and guest lectures is evaluated by tutors. Typically, FTA courses have 3 or 4 Continuous Assessment Activities that account for 80% of the final grade, while the remaining 20% corresponds to participation in class activities.

FTA Campus

All courses provided by the Free Technology Academy are conducted entirely online at the FTA Virtual Campus. This campus is fully based on Free Software applications in order to guarantee its sustainability and the transfer of the technology and expertise to all present and future partners. The base for the FTA campus was the University Campus (UC) project, a complete virtual campus developed by a consortium of Catalan universities in cooperation with the MIT that is published under the GPL license. In the case of the FTA Campus, the UC framework runs on top of Moodle, a widely used Virtual Learning Environment released under the GPL license. The FTA Campus integrates other Free Software applications such as Wordpress, MediaWiki, OpenFire and Mahara.

Quality and recognition

The overall quality policy of the FTA is laid down in a common QA plan. At the operational level, this provides for questionnaires sent to all participants (both learners and tutors) at the end of each course, the results of which are presented to the Board for decision making. At the strategic level, the Board has established a joint Scientific Council [16] with recognised international specialists to oversee QA procedures in relation to the curricula and learning materials, learner performance, tutors, learning facilities and outcomes of assessment.

Production methods in practice

The methods for the production of educational resources within the FTA are in constant evolution, as FTA partners strive to find and improve an efficient way to collaboratively produce high quality course materials. In the short time, since it started operating, the FTA has used three different non-exclusive models to produce the learning materials for its courses. These three models, outlined below, show an evolution towards a production process more open to external participation.

Quasi-static materials

The first FTA materials have been adapted from existing course books from the Master Degree in Free Software of the UOC. These books have been translated from Spanish or Catalan into English and adapted to an international audience, and in some cases new content has been developed to complete them. Other materials are being planned using a similar process, where a single FTA partner is in charge of the adaptation of an existing material. Completely new materials have also be produced in this way for the FTA, either inhouse by one of the partners or by subcontracting external experts.

The initial production model at the partner universities was an "intra-firm" model, which has over the last years evolved into a mainly "market-based" model, where internal and external experts are hired for the production of a course material, usually coordinated by one or more people from within the organisation. This model was taken as a starting point for the FTA with the participation of several partners, while still each particular course book is coordinated by one partner (see Figure 1).

This model allows the FTA to reuse existing high quality materials from the partner universities, and has the advantage of being simple to manage because it uses existing processes in the partner responsible of the material. However, it does not help to reduce the burden of maintaining and updating these materials in the future.
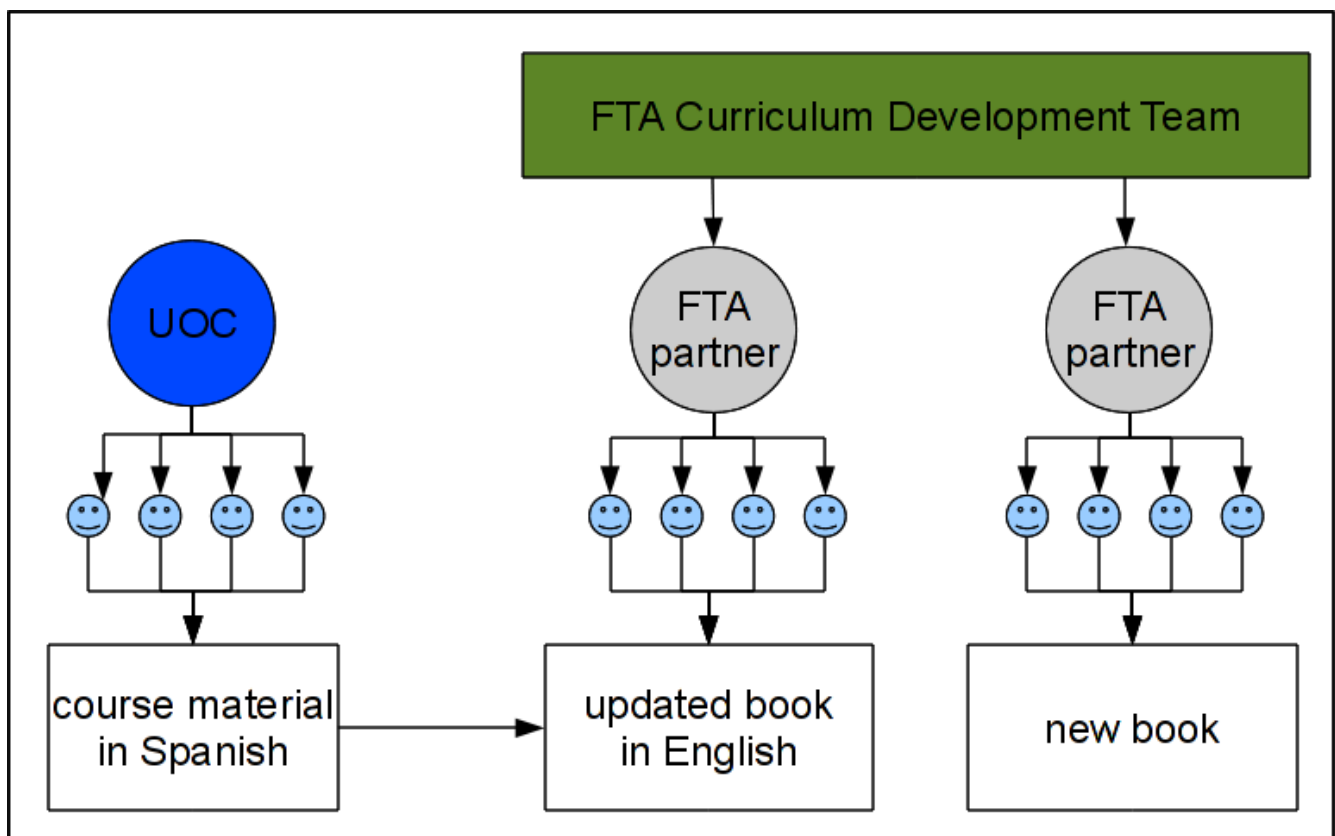

Figure 1: the first model of development of FTA materials is inherited from participating HEIs

Feedback cycle and open publication

The area of ICT, and in particular that of Free Technologies, is constantly changing and poses a moving target for the production and maintenance of educational resources. While some of the course materials used at the FTA age slowly and can be updated by the mere addition of new content, most of them need frequent revisions in order to prune and update obsolete information, cover new features in relevant applications and techniques, etc.

As a first step towards a more open process for the production of course materials, the FTA is experimenting with a process which allows any user to give feedback on specific sections of the materials using a web-based document annotation tool [17]. This will allow to centralise feedback from learners, tutors and external users of these materials in a single application, making it much easier for the FTA to review these comments in the next update of the resource (see Figure 2). A feedback loop like the one described here will help reduce the cost of maintenance of the FTA materials, but still most of the effort will be done by the FTA.
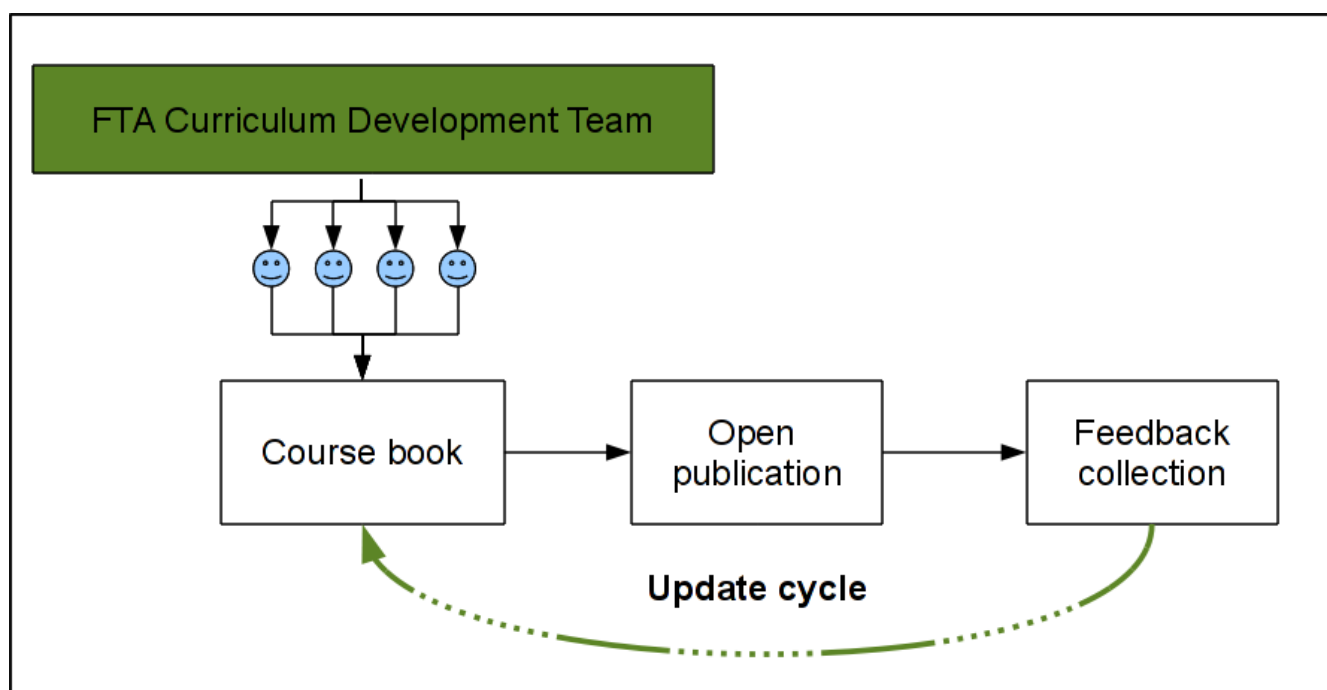

Figure 2: The second mode of development of FTA materials includes feedback mechanisms

At the same time, the FTA is working on another aspect of the production cycle that has been an obstacle for the external collaboration in the maintenance of these resources: the publication formats. FTA books have been published since the beginning in PDF format, which allows to deliver print-ready documents to all major platforms. However, as a non-editable format, PDF poses serious problems to those who wish to modify the document. The lack of an editable format was due to the fact that most of these materials were available only in a custom XML format for which the necessary tools are not readily available (see Section 3). In order to tackle this serious hindrance, the FTA has developed an application to convert this custom XML format into DocBook. This will allow a truly open publication of FTA materials under open standard file formats, both in a print-ready format (PDF) and an editable format (DocBook).

Peer production

As a third step towards a collaborative process for the production of OER, the FTA is bringing together several interested actors in the joint production of course materials. While it does not constitute a fully open process, this model will allow the FTA to engage other parties in the whole process of developing a new course, not only in the *a posteriori* maintenance of existing materials.

In this model, the FTA invites relevant experts and institutions on a particular field to participate in the development of a new course, including the authoring of course materials. The structure of the course is then discussed with the interested parties and the workload of developing the materials is distributed. The resulting OER produced this way are enriched by the previous discussion, and each participant invests only a fraction of the total resources (see Figure 3).
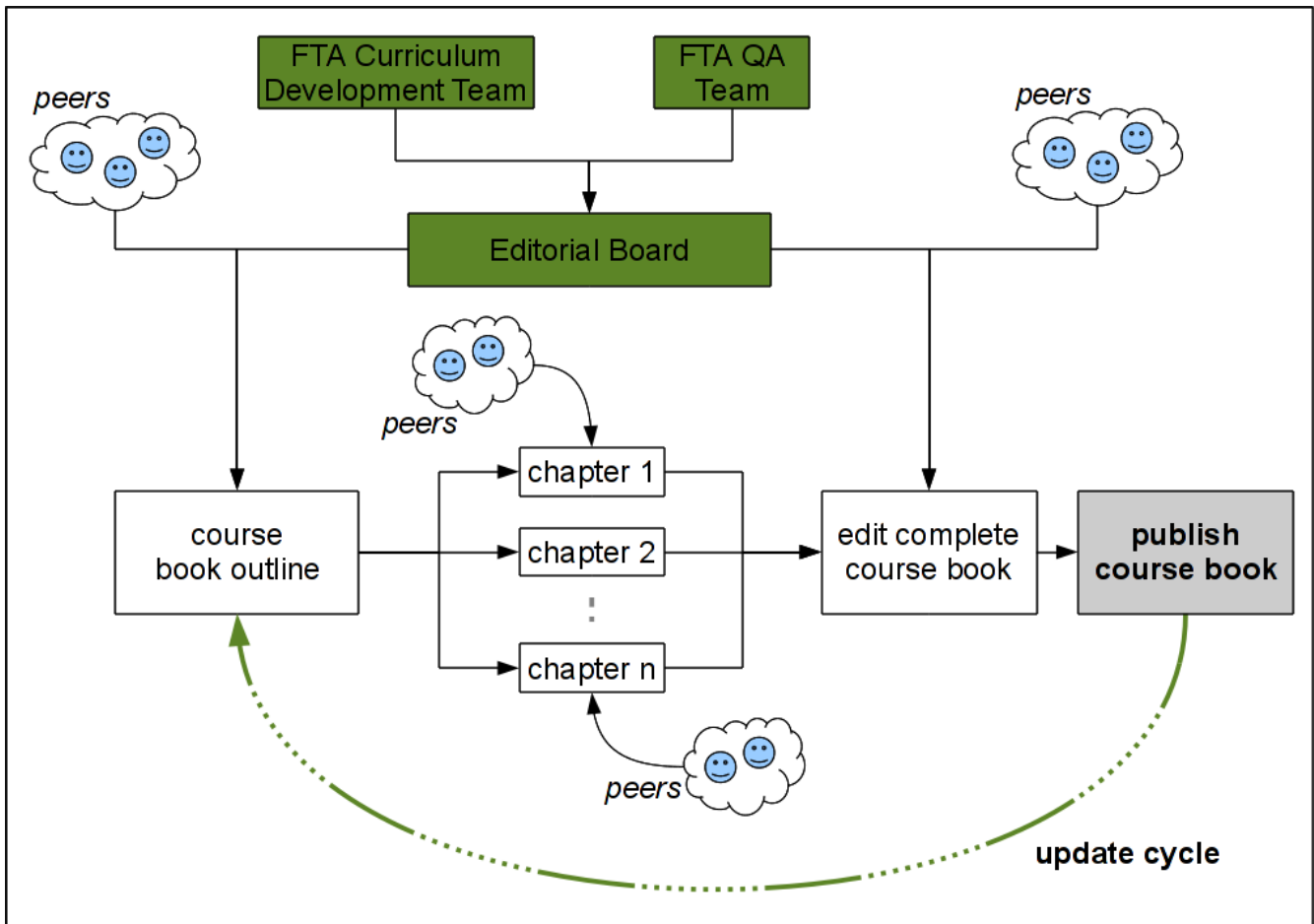
Figure 3: The P2P model includes the participation of interested actors in all the stages of development of a new material

Distribution

All FTA materials are distributed under copyleft licenses and free to download. The main distribution channel is the Materials section of the FTA website, via direct download of PDF files. As mentioned above, an editable version of all FTA materials will be made available before the end of 2010. When the load on the web server became too heavy, the main download link was directed to a BitTorrent download instead.

Download statistics have been studied for the time between February and August 2010. We have computed the number of complete downloads from the webserver statistics, plus the number of times the torrent file was downloaded using a tracker installed in an FTA server, which adds to at least 94.000 complete downloads. This is an estimation based on the number of hits in the download links and the total traffic generated by those hits, and on the FTA BitTorrent tracker. However, there are other BitTorrent files tracked elsewhere and many websites have mirrored some or all of these materials, which makes it difficult to estimate the real dissemination of the FTA materials.

It should be observed that during most of the observed timeframe only the first two course books have been available for download, while the other 5 books were made available later. The first published course book was "GNU/Linux Advanced Administration", which was responsible for 81% of the downloads during this time, and which triggered the need for distribution through the BitTorrent protocol.

Shared exploitation, Network and Cooperation

The concrete implementation of the cooperation model in the FTA is presented in the following sections.

Shared Development and Exploitation

We apply the "shared R&D costs" model in order to set up an economically efficient educational programme. This takes place in two levels: a) open the FTA Campus to external users and enable participation as much as possible, and b) build a community of partners, universities, NGOs and companies who can add value to the network [18].

Regarding the first part, the community of individuals, this can be seen as more than a conventional alumni network. Indeed, a social network has been started as part of the FTA Campus, the FTA Community Portal, where alumni and external users can share experiences and discuss topics related to Free Technologies. But, in fact, part of the learning process itself is open: the FTA Campus Wiki, which is used in almost every FTA course to gather information, summarise course outcomes and conduct group activities, is open to all users. External users also have access to Guest Lectures, and other non-regular activities will be made available for the general public in the coming months.

Regarding the second part, the partner network, the philosophy behind it is based on shared costs and shared revenues. The FTA's exploitation plan formulates the common goals of sharing resources and concentrating efforts to make the Academy successful and contribute to the building of a critical mass of experienced and skilled professionals, teachers and decision makers in the area of Free Software and Open Standards. It is expected that, due to the collaboration in the context of the FTA, partners can contribute to these goals and benefit from the results of the collaboration, while investing each only a fraction of the overall effort. The investments are shared as are the benefits. Partners add resources for conducting the course programme and share the costs of development of additional courses, quality assurance and international recognition.

As mentioned above, the FTA performs a joint exploitation of the educational programme between its partners. In this sense, the FTA offers its partners various economical opportunities, such as sharing costs in the production and maintenance of a common curriculum, course materials and a state-of-art study programme; a shared platform for joint communication to reach out to learners and potential staff; a virtual campus infrastructure that is jointly developed and maintained; and a common set of quality assurance and recognition procedures. At the same time, income generated by tuition fees and the sale of printed copies of course materials is also shared among FTA partners.

Revenue model

Drawing upon the lessons from Free Software, the FTA offers a "fully Free Knowledge" programme, compared to "fully Free Software" in the FLOSSmetrics research. Revenues are generated from educational services, which mainly refers to guidance during a course by a specialised tutor, continuous assessment and an FTA certificate which is recognised by partner universities. Currently, these three elements are offered in one tuition fee per course module. Early registrations for courses are awarded with discounts. Additional to the revenue from tuition fees, the FTA partners have recently started to provide a Print-on-Demand (PoD) service to ship printed copies of digital course books to registered learners.

Activity based costing model

As the income and expenses of the Academy's operations depend to a very large extent on the number of courses and learners, any exploitation should be based on these so called activity drivers. In order to make an operational planning, we need to define the cost levels per activity for the normal operation of courses in a distance learning programme such as the one being set up at the FTA.

While trying to limit financial risks for the partnership and at the same time to provide an attractive educational services offering, we need the costs to be in line with the level of activity. In other words, we try to follow an "Activity Based Cost" model. The main cost drivers are the number of courses and the number of participants in a course. Where possible, we compute the costs of an activity as a cost tariff per learner per number of ECTS credits per course. Only for those activities which are independent of the level of activity, we work with fixed costs. With this model we aim to assign costs fairly to activities and partners and set up the Academy as a very scalable enterprise: when the number of courses and learners grows, more partners, teaching staff and other personnel can find a place. At the same time financial risks and margins are kept low; margins mainly cater for the further development of the Academy and its course programme.

The pilot programme

The total number of single course registrations in the 2010 programme is 158 learners over 7 courses. The number of unique learners is smaller than this total, as several of the participants in the first and second course runs trimester have later registered for other course modules in posterior course runs.

Future scenarios

The challenge of the FTA is to reach economic sustainability, i.e. to break even between costs and revenues. With the cost tariffs for each activity different scenarios for the numbers of learners and courses run in a year have been computed (see Table 1).

Scenario	Low	Medium-1	Medium-2	Medium-3	High
# courses:	15	15	18	20	30
# learners/course	20	25	27	30	35

Table 1: Sample scenarios for the 2011 FTA Programme

Break even lies around Medium-2, while Medium-1 and Medium-3 scenarios produce slight losses.

Conclusions and recommendations

The production of OER must be sustainable both in the production and the economic points of view. The FTA project addresses, among other issues, both objectives by incorporating an OER development cycle and a set of services around these OER which generate revenues.

The FTA tackles the development cycle of educational materials by offering different production models: a) the production of a course material by a single partner of the project ("inhouse"); b) collecting feedback to update and improve future versions of the materials; and c) the distributed production by a set of interested parties. In any case, the materials considered as "official" within the project must be supervised and approved by a set of experts belonging to any of the HE institutions which constitute the FTA consortium or associate partners to guarantee their scientific and academic correctness.

From the economic point of view, the FTA generates revenues by offering a set of services around the produced OER. These services are mainly (though not exclusively) educational, since courses are delivered on-line using the FTA campus with expert tutor guidance, and diplomas are issued when students accomplish the learning objectives of each course. These diplomas are recognised by the official educational programmes offered by the HE institutions integrated in the FTA network. In addition, the FTA also offers a Print on Demand service which allows to obtain physical copies of the books at a reduced price. Obviously, both the production of materials and the services provided involve a set of costs. The FTA has worked on several scenarios including fixed and variable costs and how these can be covered by the generated revenues, which show that the economic sustainability of the process is possible under some realistic conditions, which include a target number of students and courses.

Hence, the FTA tries to solve the sustainability problem of OER production and sets up an example which may be replicated in fields different from Free Software and Open Standards by interested parties.

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