Economic Models of Digital-Only Journals

L. Halliday and C. Oppenheim

Paper presented at the UKSG 23rd Annual Conference, Keele, April 2000

This project explores the economic aspects of digital-only journals using ithink Analyst, a modelling software package. Three models have been produced using simulations to test model sensitivities. This paper first describes some background to the models, the software and how it was used. Each model in turn is then described and finally, the paper outlines plans to further develop models of digital journal production and delivery.

L. Halliday and C. Oppenheim (presented by L. Halliday) Department of Information Science, Loughborough University, Loughborough, Leicestershire LE11 3TU, UK

Background

A lot of development of digital journals, especially digital parallels of print journals, has been conducted by commercial publishers. Their pricing models do nothing to address the serials crisis. The most innovative pricing models have been developed by stakeholders from within the higher education (HE) community. They seek an effective and affordable system for disseminating peer-reviewed scholarly articles. Their models often bypass commercial publishers; in other words, the journals are produced by the HE community. Proponents of these models claim that digital publishing can be significantly cheaper than print publication. They argue that as much as 70% of the total cost of journal production and distribution is incurred by printing and distributing print copy and that this is saved in a digital environment. This is contested by publishers, who claim that 70–80% of journal production costs are fixed. Variable costs, including print and distribution, they claim, account for only 20–30% of the total. Some of the difference between these positions is related to level of functionality that writers assume is necessary. Proponents of alternative models argue that many publisher functions are unnecessary. Their models are often based on production of unsophisticated text articles produced at significantly lower cost. This approach can be criticised for two reasons.

First, journal users expect additional functionality. They anticipate that digital journals will allow them to work more efficiently. Users consider core features to include the ability to browse, search and print, good system performance, critical mass and currency, and the facility for seamless discovery and access. User acceptance is essential if digital journals are to succeed.

The second criticism is that the elimination of some of the

filtering and organisation that is traditionally done by publishers increases the work of librarians and end users. The net effect on the academic community is likely to be increased cost.

For these reasons, we rejected the proposal that the end product be unsophisticated text. Our models assume the core level of functionality that users demand. The development and inclusion of this enhanced functionality requires technical skill that is expensive. Publishers claim that the additional costs more than compensate for any savings from print and distribution. They argue that digital journals cost at least as much to produce and distribute as print journals.

It is difficult to compare the cost of digital and print journal production and distribution. Publishers are reluctant to disclose costs. Even if they did so, it would be difficult to compare journal costs across companies because different accounting practices are employed. The publishing industry does not employ activity-based costing. There has been some academic work on activity-based costing of print journals, notably that of Carol Tenopir and Don King. The costs associated with digital publication are, as yet, unknown. The activities that incur those costs have yet to stabilise, making it difficult to determine costs.

We are building activity-based models so that we can develop a better understanding of the production and delivery of digital-only journals and of the different roles and costs involved in that process. These models also allow us to explore alternative cost-recovery and pricing mechanisms.

To date, we have built and tested three models of digital-only journal production and delivery. These models were based on a review of the literature supplemented by personal communication with practitioners. The models were built as part of a project which evaluated economic models of a number of aspects of the digital library within a four-month period [1]. This year, we will be conducting interviews with several stakeholder groups and revising the models in line with the data collected.

The models

The three models that we have developed are now described. Although obviously, journal production and delivery is an international business, these models were built from a UK perspective. Thus, for example, staff costs are based on UK figures and where value added tax (VAT) is applicable in the UK it is applied at the rate of 17.5%.

We have described the first model as 'traditional'. It models a process similar to that of print journals but it does not include production of print. In this traditional model, authors and referees and editors are unpaid. Editors receive from the publisher only a contribution towards editorial office costs. Production and delivery costs are recovered through sales of subscriptions and individual articles.

The model differs from print production in that the entire editorial process is conducted electronically and the product is delivered to libraries in electronic form.

The second model is of a non-commercial journal that is available for use free of charge on the Internet. This model is based on the work of Stevan Harnad. His model is based on the premise that academics submitting papers to journals for publication seek to disseminate their findings as widely as possible and would be prepared to contribute to costs to facilitate widespread dissemination.

In a print environment, it was necessary to accept access restrictions because print publication is expensive and publishers had to recoup their costs. In a digital environment, Harnad argues, costs can be reduced by as much as 70% bringing them to a level that can be recovered from authors rather than subscribers. Harnad proposes that authors pay page charges and that journals be available to all users free of charge on the Internet. He suggests that the author fee should be around $400 for a 20-page article. Recovering costs from authors would actually contribute to cost reduction as subscription administration would be unnecessary.

The third model is a free-market model. It is based on a supporting study commissioned by the UK Electronic Libraries Programme (eLib) and conducted by Fishwick *et al*. in 1998. Fishwick *et al*. compared a number of different models for pricing electronic scholarly journal articles. Their report suggested that the current academic information delivery chain is inefficient

due to a number of distortions in the supply–demand chain. Among these are that: (1) authors represent a principal source of demand for publication but make no contribution to publication costs; (2) those consuming the information, i.e. the readers, seldom pay for it, preferring instead to obtain it from libraries; and (3) much of the journal publication work is undertaken by editors and referees without payment, or with minimal honoraria.

Fishwick *et al.*, proposed an alternative model which introduced 'normal' market feedback mechanisms into the academic information delivery chain with a view to overcoming the serials crisis and developing an efficient market for scholarly articles. Publication would be funded by a combination of author submission fee and by sales of subscriptions and/or individual articles. Thus, both authors and users would contribute to costs reflecting the fact that both contribute to demand. Editors and referees would be paid to encourage efficiency, and authors would receive royalties to encourage them to submit for publication only material of the highest quality. The system includes a mechanism to support authors who cannot afford to pay a submission fee. The editorial office would apply to charitable foundations to fund these papers. Papers would then be available individually or in customised bundles from the publisher database.

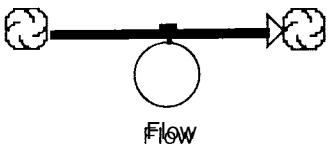
Fishwick *et al*. also suggested that end-user access to journals be rationed even to materials obtained by site license. They argued that this would force end users to prioritize and thus that usage data would be more useful to librarians and publishers as it would reflect real need.

All three of our models represent the full publication cycle from receipt of manuscripts by the editor to delivery to end users. The resources required to produce and deliver journals are similar in each model. Staff costs are most significant. All of the models include two half-time staff responsible for production and systems. In the market model, where editors and referees are paid, the total financial cost is substantially higher than in the other models. In all models we included an overhead on staff costs which represents, for example, buildings and support such as personnel and training, i.e. resources that are not related directly to products such as journals. We pitched the overhead rate at 120%. This reflects true costs in a large organisation such as a university. As these alternative models are proposed as HE-based operations, we think it realistic that they be costed as if they are housed in universities. It is important to recognise that just because work is undertaken without charge does not mean that it is cost free. In economic terms production that distracts an academic from her/his core tasks, i.e. research and teaching, may be more expensive than production that is undertaken by someone with the required skills who is dedicated to journal production. Nevertheless, we recognise that it may be possible to produce journals in a leaner organisation so we applied the overhead at 60% and re-ran model simulations for comparison. We also varied the surplus applied from zero to 20% in two of the models. We assumed that some surplus would be required for development of the journal. The free-access model does not include a surplus. It is a strictly non-profit model.

Modelling software and simulations

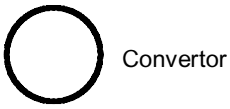
The software package we used is called Ithink Analyst[2]. Four key element types are used to build Ithink models.

A stock represents an accumulation. The items accumulate by flowing into the stock (see description of the 'flow' below). They also flow out of the stock. In many of the stocks represented in our models the inflow and outflow are equal. For example, a journal editor receives a number of manuscripts every year. Of those, he or she rejects a very small percentage and the remainder are sent for peer review. The same number of manuscripts enter and leave the editorial office.



A flow either fills or drains a stock in the direction of the flow arrow. A cloud at either end of a flow indicates an infinite source, or destination of the material flowing to or from a stock. Basically that indicates that the source of

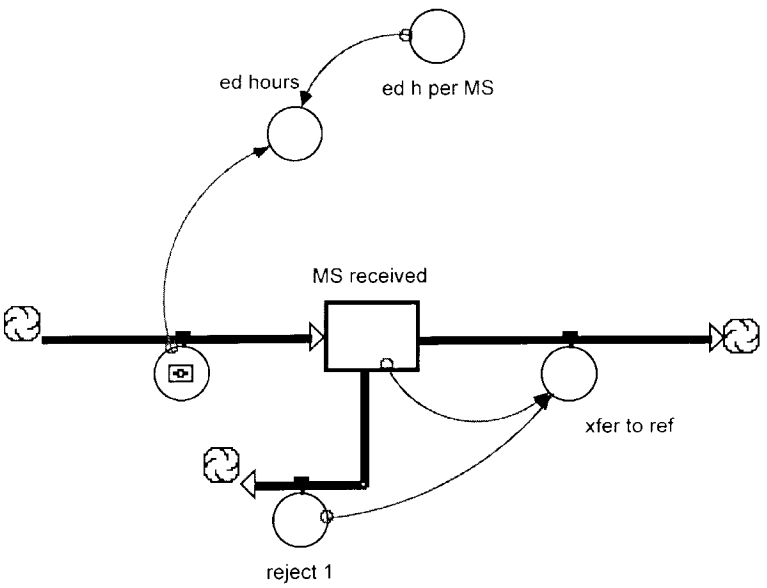
material passing through the flow is beyond the scope of the model.



A converter informs other elements in the model. It may contain a constant value, e.g. tax at 17.5%, an incremental value (e.g. 1 in year 1 and rises by 1 in each subsequent year), a variable (which can be manipulated by a model user) or an algebraic relationship between different elements in the model.

Connector

A connector is like a wire which transmits information between elements in a model, e.g. in the chunk of model shown, the flow labelled 'xfer



to ref' represents the number of manuscripts that are sent to referees to be reviewed. The value of this flow is determined by the number of manuscripts received by the editor (MS received), and the number rejected immediately, e.g. because the subject is unsuitable. The value of the converters is conveyed to the flow by connectors.

Each of our models consists of four interconnected sectors: content origination, publication, information brokerage, and the library function. The models all simulate production of a small journal which publishes 120 10-page papers per annum. We used Ithink to represent graphically the interrelationships that characterise each system. We then defined numerically each element in the model. Some of these definitions are equations which describe the relationship between two or more elements in the model.

The bases of the equations and the assumptions in each model element are described within the model in element 'documents'[3]. These can be viewed by a model user. The models are designed to be used rather than viewed. Although we deliberately kept them as simple as possible, the systems modelled are fairly complex.

Results

We varied the value of elements in each of the three models and ran a series of simulations to establish the costs and benefits for different stakeholders of manipulating elements in this way and also to identify model sensitivities. As you can see from the picture above, each model has a large number of elements which could be varied and the effect monitored. The scope of the project severely limited the number of simulations that we were able to run. However, we have offered to supply copies of the models to anyone who would like to manipulate them. The models can be opened and simulations run using a free runtime version of the Ithink software which is available from the Ithink Web site.

The results of some of those simulations are now discussed.

Traditional model

First, we ran a series of simulations to determine the subscription price of a traditional-model journal if the following elements were varied: the overhead rate applied, the profit margin applied, and the size of the subscription base.

The results are shown in Table 1.

It is clear from these figures that a journal

Table 1: Traditional electronic journal model simulations to determine subscription fee if overhead rate, profit margin and subscription base size are varied.

Overhead rate	120%			60%		
Profit margin	0%	10%	20%	0%	10%	20%
	Subscription fee (£)					
No. of subscribers						
200	675	741	810	491	540	589
500	270	297	324	196	216	236
1000	135	148	162	98	108	118
2000	67	74	81	49	54	59
20,000	7	7	8	5	5	6

making a modest profit and recovering full costs can be supplied to users for a modest fee as long as the subscription base consists of at least 500 subscribers. This gives an idea of how cheap journals can be without adopting an alternative cost-recovery model.

Free-access model

We also ran simulations to determine the level of author fees that would be required to fund the free-access model. The results are presented in Table 2. These fees were submission fees, i.e. they are based on the assumption that all authors whose papers are refereed contribute to costs. It has been argued that all authors should contribute to journal costs as some costs are related to administration and refereeing of papers regardless of whether they are accepted. It may be unrealistic, however to expect those whose papers are rejected to contribute. Fees paid only by authors whose papers were accepted, would be close to the higher of each pair of figures quoted here.

Table 2: Harnad electronic journal model simulations to determine author submission fee if overhead rate, and journal rejection rate are varied.

Overhead rate	30%		60%		120%	
Rejection rate	10%	90%	10%	90%	10%	90%
Submission fee (£)	518 (52/page)	37 (4/page)	639 (64/page)	71 (7/page)	879 (88/page)	98 (9/page)

Harnad suggested that fees of tens of dollars a page rather than hundreds of dollars a page would be acceptable and estimated that it would cost approximately $400 to produce a 20-page article. This gives a page charge of $20 which is insufficient to support our model. That is not surprising considering that ours is a model involving the employment of paid professionals to produce a journal with what we consider to include core functionality. Harnad suggests that professional publishing staff are unnecessary. His model relies largely on unpaid contributions. Nevertheless, the fees generated by our model fall within a range that some authors consider acceptable. Some US journals currently levy page charges at around that rate. However, author fees are not popular outside the US. Acceptance of the free-access model requires authors to take a system-wide view of the costs and benefits of scholarly publishing as it affects the whole organisation including the library. The main barrier to implementation of this model is cultural. One journal, based on this model, has been launched recently. It is the *New Journal of Physics* published by the Institute of Physics Publishing (www.njp.org). Authors pay $500 per accepted paper. The journal was launched 18 months ago. To date, it has published only 27 papers. It is unclear why NJP has published so few papers. It may or may not be related to the cost recovery mechanism. It may reflect the fact that the physics community does not need another journal of this type. Regardless of the medium, if there is no niche to be filled, it may be difficult for a new journal to establish itself.

The market model

Clearly, the financial cost of producing a market-model journal is high because editors and referees are paid and authors receive royalties on their papers. Again, I will report on subscription fees and author fees. Fishwick *et al.* suggested that published papers be sold to users either by subscription to the publisher's whole list, by subscription to specific parts (e.g. within a

specific subject areas), by a two-part tariff which consists of a reduced subscription price combined with reduced transaction cost per individual article, or simply on a pay-per-use basis. We were unable to explore the likely proportion of subscriptions to sales of individual articles but we did consider the effect of sales of individual articles on author royalties. The author fee pays for editorial and refereeing work and contributes 10% of production costs. The author receives a royalty of 5% on subscriptions income and sales of articles. The administration of royalty fees adds to costs in this model as do additional tasks associated with unfunded papers – Fishwick *et al.* suggested that the editorial office should seek funding for these from appropriate charities.

Obviously, the rejection rate has little impact on submission fees in this model because author fees contributed to only 10% of production costs. The rest of this fee pays editors and referees who are unpaid in other models. Fees are not much lower than those generated by the free-access model. Yet in the latter, the journal is available free of charge to end users whereas in this model subscription fees are also charged.

Table 3: Fishwick electronic journal model simulations to determine author submission fee if overhead rate, and journal rejection rate are varied.

Overhead rate	60%		120%	
Rejection rate	10%	90%	10%	90%
Submission fee (£)	414 (41/page)	357 (36/page)	447 (45/page)	368 (37/page)

In this model, we varied the value of the following elements to determine the effect on subscription price: rate of overhead; profit margin; and size of subscription base. The results, recorded in Table 4, show that the subscription price of a market-model journal is barely less than that for the traditional model journal and the latter does not include a submission fee.

Royalty income is related to the sale of subscriptions and individual articles. The royalty is included in the market model as an incentive to publish only high-quality material. The royalty rate is related to journal income. Income is static as any increase in subscriber numbers is used to reduce the price of subscriptions and articles. Thus, author royalties increase only in relation to those of other authors published in the same journal, i.e. a relatively popular paper will generate more income for its author than one that is not frequently read. A paper attracting 22% of royalties generated for a journal volume would recoup the author fee.

Finally, we revised the traditional model to explore the figures generated if both authors and subscribers contributed to costs. This would effectively distribute costs across two groups both of which contribute to demand. The results were promising. The subscription fees generated by the traditional model are modest without author contributions. Author fees reduce them further. However, administration of both sets of fees would add to costs. It is often argued that authors and end users are drawn from the same group so the distinction is not necessary. This is not entirely true however as many journal readers never write papers. These readers tend to come from industrial, professional and clinical settings, i.e. they are not part of the academic research community. Thus, journals funded only by author fees would subsidise these users. The question to be asked is whether or not this matters as long as scholarly publication is as efficient as possible for the academic community.

Table 4: Fishwick electronic journal model simulations to determine subscription price if overhead rate, profit margin and number of subscribers are varied.

Overhead rate	120%			60%		
Profit margin	0%	10%	20%	0%	10%	20%
	Subscription fee (£)					
No. of subscribers						
200	442	486	530	607	668	729
500	177	194	212	243	267	291
1000	88	97	106	121	134	146
2000	44	49	53	61	67	73
20 000	4	5	5	6	7	7

Discussion

These models are first drafts. They contain flaws and omissions. Some we have

discovered and some remain to be discovered. An example is the fact that we were unable to separate subscriptions administration and maintenance from other publisher costs. We would have liked to represent costs associated with subscriptions by calculating part of the overhead as a percentage of sales income. This would reflect the fact that costs vary with the number of subscriptions. However, calculating the overhead in that way would have required a circular connection between model elements which is prohibited by the software package. It is important that we isolate subscriptions-related costs because they are eliminated when costs are recovered from authors. A fair comparison between models that recover costs only from authors and those charging subscription fees is impossible unless we can do so. During data collection this year, we hope to ascertain how the digital environment changes subscriptions administration and what costs are involved.

Another factor that is very important is the staffing level required to produce a digital journal. This may or may not be correctly represented in our models. As staff costs and the overheads on them are the most substantial costs, any alteration to staff levels will have a significant impact on total costs.

Despite their flaws, these models have been useful for developing our understanding of the digital-journal production and delivery process and for eliciting feedback. That feedback will inform model development this year. We will also be interviewing publishers, librarians, and academics in their roles as authors, referees and editors. Our model development work this year will not be a simple revision of the models described here. We will use elements of the traditional and the free-access models. We will not, however, develop the market model further. Although Fishwick *et al.* identified elements in the current system that make it inefficient, there is no guarantee that a free-market model will be any more efficient. It might replace current faults with new ones. For example, Fishwick *et al.*'s suggestion that end-user access to articles be rationed suggests that end-users currently waste resources by gathering information that they do not need. Given that researchers' time is scarce, this seems unlikely. Rather than making the system more efficient, rationing might prejudice researchers' ability to do their jobs. This is a potential practical problem. There are also cultural barriers to the market model. It is important to some academics in their roles as authors, editors and referees, that scholarly publishing operates independently of market forces. They believe that direct financial remuneration introduces motives that have no place in the system. For these reasons, we will not be exploring this model further.

We intend to develop two models over the next year. The first will be a 'cottage-industry' model, i.e. a model of journal production in a small, lean organisation. The second will model publishing in a large organisation. We suspect that the size of organisation is a key distinction between publishers with regard to costs. These models will be flexible in that we can vary values of certain elements to explore commercial and non-commercial status and different cost recover mechanisms.

References

1 The report from this project is available at the following URL: http://www.ukoln.ac.uk/services/elib/papers/supporting/#ukoln

2 Information about Ithink can be found at the following URL: http://www.hps-inc.com/bus%5Fsolu/ithink/demo_gate.htm

3 They are also documented in the report of our project which is available at the following URL: http://www.ukoln.ac.uk/services/elib/papers/supporting/#ukoln.