The Cornell Experience: arXiv.org

Anne R. Kenney

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CORNELL

How do we identify the requisite resources to maintain a digital repository?

“If we had some horses, we’d have a cavalry – if we had some men."

Victor Mature in *Demetrius and The Gladiators*, 1954

Step 1. Identify Cost Categories

Cost categories

- Startup costs
- Ongoing costs
- Contingency costs

Step 2. Identify Cost Centers

- Capital costs
  - Technical/procedural infrastructure
- Direct operating costs
  - By OAIS functions, e.g., ingest, data management, storage, preservation planning
- Overhead
  - Indirect operating expenses, e.g., facilities, general/administrative/ support services

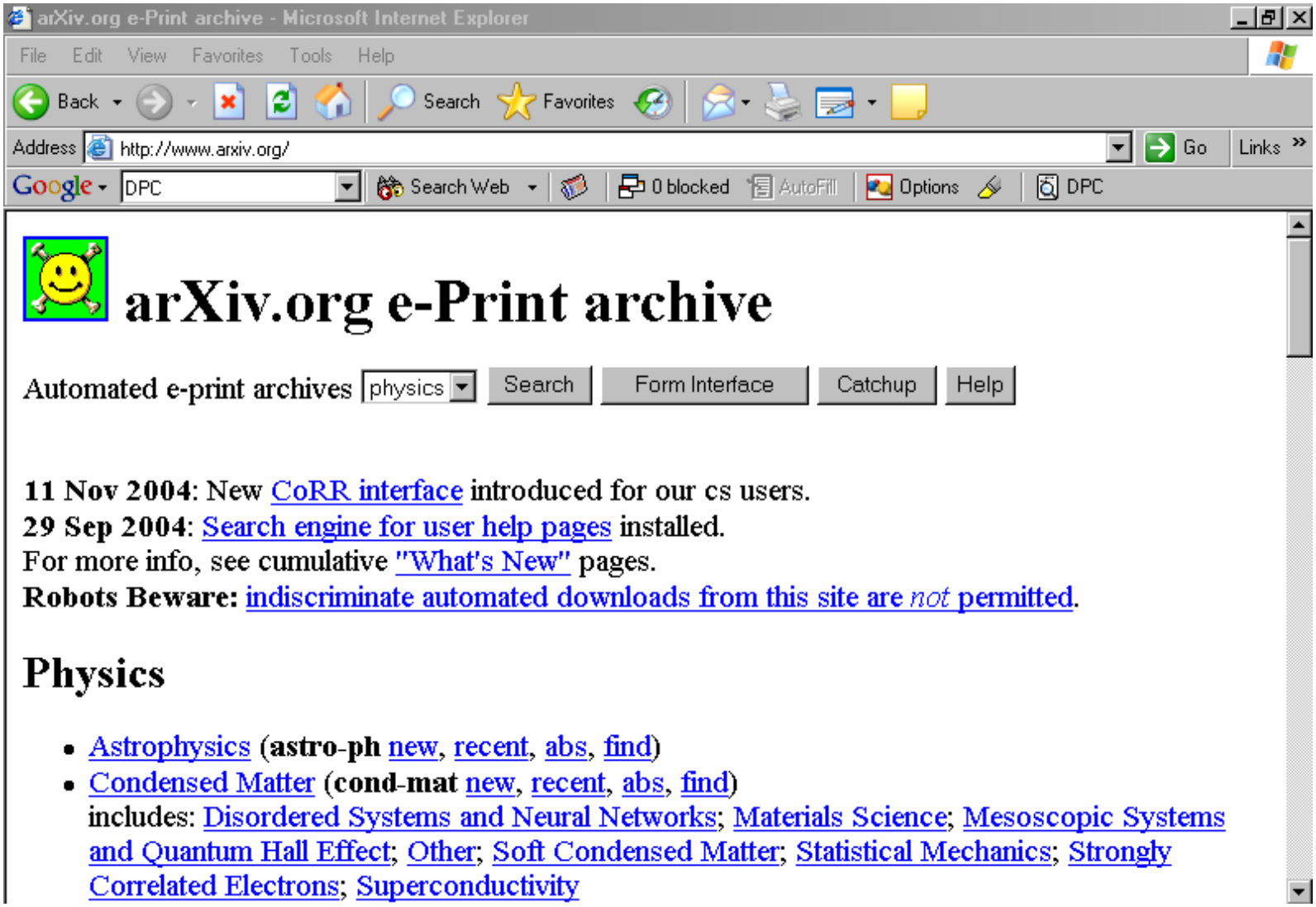
Step 3. Calculate Costs

- System(s)
- Staff
- Ancillary staff expenses
- Services and fees
- Supplies and materials
- Other

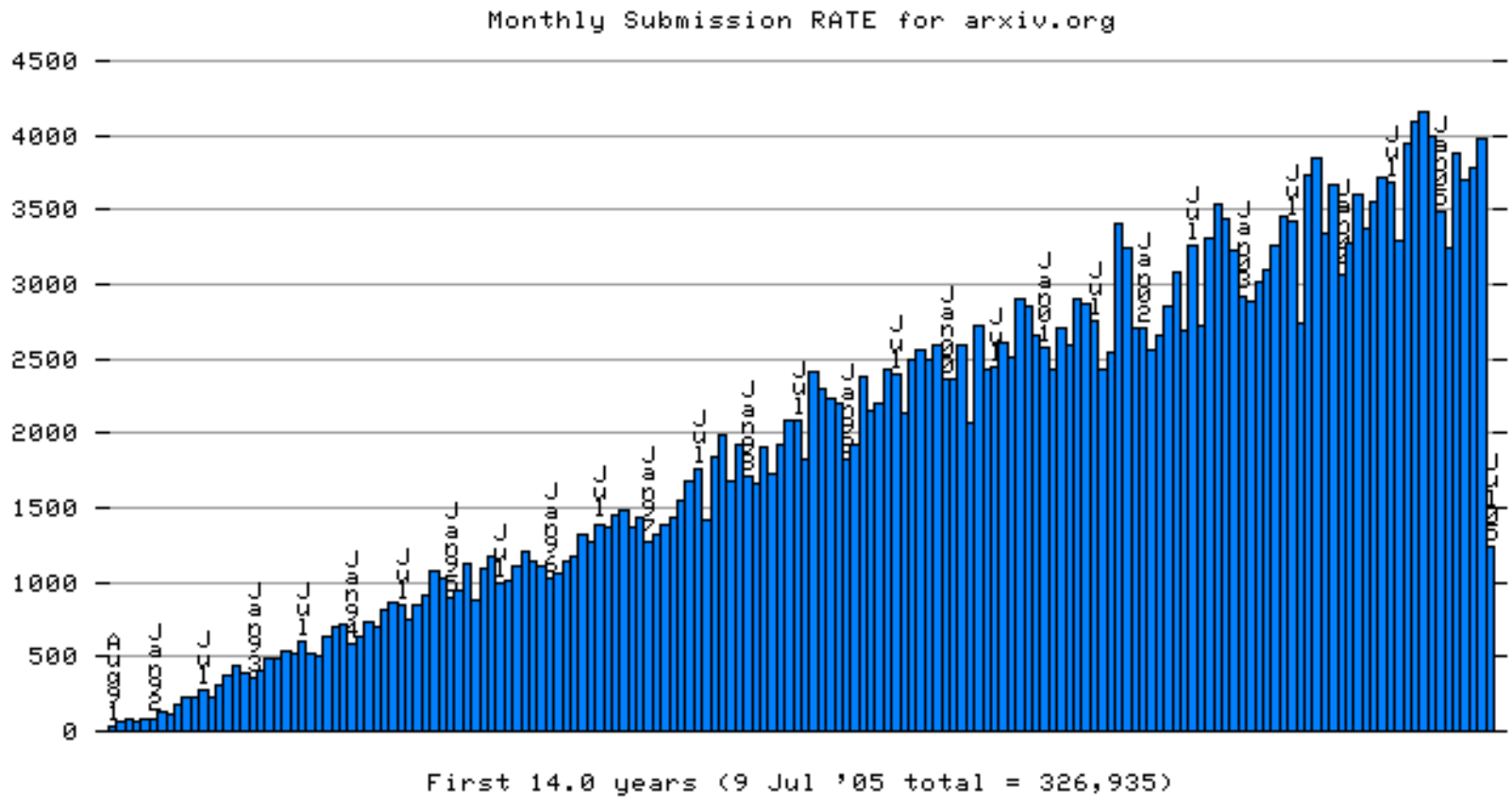
Case Study: arXiv.org

- automated electronic archive and distribution server for research papers in physics, cs, math
- Begun in 1991; transferred to CU Library in fall 2001
- 326,000 items by FY2004/5; 45,000 submissions this year
- Cost/submission: $1-$5

arXiv.org Main Page



Monthly Submission Rate



Hourly Use Data of arXiv.org

arXiv web server usage for 21 Jul '05 (arxiv.org site only)

Hour_Total__Connections

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00 __11861_ |||||||||||||||||||||||||||||||| **11861**
01 __21946_ |||||||||||||||||||||||||| **10085**
02 __33240_ |||||||||||||||||||||||||||| **11294**
03 __46439_ |||||||||||||||||||||||||||||||| **13199**
04 __60527_ |||||||||||||||||||||||||||||||| **14088**
05 __73932_ |||||||||||||||||||||||||||||| **13405**
06 __87277_ |||||||||||||||||||||||||||||| **13345**
07 __99237_ |||||||||||||||||||||||||||| **11960**
08 _112155_ |||||||||||||||||||||||||||||| **12918**
09 _126827_ |||||||||||||||||||||||||||||||| **14672**
10 _141809_ |||||||||||||||||||||||||||||||| **14982**
11 _157772_ |||||||||||||||||||||||||||||||| **15963**
12 _170933_ |||||||||||||||||||||||||||||| **13161**
13 _183045_ |||||||||||||||||||||||||| **12112**
14 _193269_ |||||||||||||||||||||||||| **10224**

Total number of connections = 193269 (+72 local & administrative connections)
Current local time is *Thu, 21 Jul 05 14:56:06 EDT*

Capital Equipment

Annual equipment cost =

- purchase price of hw/sw
- amortization rate (3-5 year range)
- annual maintenance,licenses, and development fees, estimate at 20%-50% purchase price

arXiv Server Costs

- Equipment cost: $10,600
- Amortization: 5 years
- Annual fees: $2,403
- Annual equipment cost = $4,523($10,600/5 + $2,403)

Equipment costs/ preserved digital object

- Calculated by dividing the annual equipment costs by the current database and estimated growth rate of digital objects.
- The greater the number of similar digital objects, the lower the per/object equipment cost.
- The more streamlined/automated the processes, the cheaper the cost.

ArXiv Annual Equipment Costs (FY2004/05)

- 326,000 submissions
- 45,000 in FY 2004/5
- $4,523/45,000 =

  $ 0.10/submission
- $4,523/326,000 =

  $.01/item/year

Calculate Personnel Costs

- Staff performing specific tasks, management overhead, ancillary expenses
- Calculate staff costs on “weighted hourly rate” not salary, which is over twice the hourly wage

Weighted Hourly Rate

1) Avg. number of workdays/ year
2) Number of hours/day
3) Number of productive hours
4) Weighted hourly rate =

$$\frac{\text{salary + fringe}}{\text{productive hours}}$$

Calculating The "Real" Costs at Cornell

Staff:

- 222 day work year (excluding vacation, sick, personal and holidays)
- 7.3 hour work day (excluding breaks)
- 1,621 hours/year at work
- Assume 75% "production time": 5.5 hours/day and 1,216 hours/year
- "Weighted hourly rate" =

$$\frac{\text{salary + fringe}}{1{,}216}$$

ArXiv: Programmer/ Analyst Band F

- Annual hours worked: 1,216
- Salary: $57,000
- Benefit rate: 32%
- Hourly wage: $28
- "Weighted hourly rate":
  $\frac{\$57{,}000 \times 1.32}{1{,}216} = \$62$

Weighted rate is 2.2 times the hourly wage

Management and Ancillary Costs

- % of management overhead assigned/staff member
- Annual ancillary expenses (min: $4,000/year)
  - training, travel, workstation support, supplies, phone/data, reference materials
- Overhead

Example: Full Freighted Programmer/Analyst

$62.00 (WHR)

+ $ 6.85 (8% mgr overhead)

+ $ 2.32 (ancillary expenses)

$71.70

x $ 1.58 (overhead)

$113.29

Calculate Services Costs

- Annual or contractual fees paid for out-sourced functions, including backup, space in server farm, mirroring
- Related services & expenses, e.g., technology monitoring, subscription to software repository, consortial fees, royalties, memberships

Calculate Contingency Costs

- Unanticipated expenses associated with trigger events, catastrophes, technical sea changes
- Varies depending on size of effort, complexity, experience

Calculate Overhead Costs

- Negotiated rate vs. itemized expenses
- Recovered or absorbed
- How much comes back to the digital repository

ArXiv Annual Costs for Maintenance/Preservation

- Equipment: $4,523
- Staff (2 FTE): $150,480
- Mgt overhead: $15,000 (8%)
- Ancillary staff costs: $8,640
- Contingency: $17,568
- Overhead (58%): $112,084
- Total: $305,333/year

Total Costs

- 326,000 submissions; 45,000 in FY 2004/05
- $305,333 /45,000 =

  $6.79/submission
- $305,333/326,000 =
  $0.94 /item/year
- $305,333/163 GB =$1,873/GB

Maintaining/Preserving ArXiv

- Staff costs represent the greatest expense
- Present day costs do not equal future costs
- Total costs will decrease only with automation of human effort
- Per submission and per item costs will continue to decrease as the collection grows

“Stewardship is easy and inexpensive to claim; it is expensive and difficult to honor, and perhaps it will prove to be all too easy to later abdicate.”

Cliff Lynch, 2003

“They say you can’t do it, but remember, that doesn’t always work.”

Casey Stengel