#### Global Software Development in the FreeBSD Project

Diomidis Spinellis Athens University of Economics and Business

### Outline

- FreeBSD
- Methodology
- Findings
  - Global development
  - Productivity and quality
  - Human interactions





#### FreeBSD

- Complete operating system
- Derived from BSD Unix
- Focus on stability and reliability
  - Yahoo's s servers



- Part of Apple's Max OS X





#### Development



#### Kernel ~2.8MLoC

#### Operating system utilities ~9.8MLoC

ocumentation

Third party application ports ~12000



## **Development Facilities**

- CVS (10 years of historical data; >938k) GNATS
- Problem reports (>95k)
- Mailing lists (>100)
- Tinderbox
- Web site
  - Developer's handbook
  - Release engineering
  - Browsable CVS
  - Mailing lists
  - PRs





### **Development Process**

- Unpaid volunteers
- Teams
  - Core
  - Release engineering
  - Security
  - Ports
  - Donations
- Committer etiquette
- Mentoring







#### Global Development









#### **Division of Work**





#### Hold and Advance

Work type per area





#### ... and Fix

Closed GNATS entries per area





#### **Roads and Buildings**

Work type per area











## Productivity and Quality

- + Round the clock development
- + Software and hardware diversity
- Lack of face-to-face communication
- A synchronous communication
  A more rigorous process is required
  Cultural diversity



#### Productivity

 More developers produce more software (base case)











#### Human Interactions

- Look for neighbors
  - Cooperating developers
  - Mentors and mentees



#### Cooperating developers

Mean distance between

- any two FreeBSD developers: 6,701km
- 4010 instances of commits
  - Same file
  - Same day
  - Different developers
  - Mean distance:
     6,489km





#### Mentors and mentees fjoe 4865 2810 kris krion njl danfe osa 120879817 9769 2119 7991 2104 2718 8873 8805 .142 edwin philip marks arved brooks sergei sem novel /16177 326 779 15 2717 markus ehaupt erwin ceri barner αz 1406/150 679 1121/ 7722\2216 150 7357 Ith brueffer clement simon linimon brd roam 16740 661 8348 951 $\frac{1}{4}$ $\frac{3}{4}$ Min Media Mean remko joel Max lawrance ٧S 2.2 7.8 6.7 9.3 Any 0 19 M/M0 0.7 3.8 5.0 8.8 18

# GSD Works

- Round the clock development
- No ill effects on
  - Productivity
  - Code quality
  - Bug density
- Distance
  - Doesn't show up in ad hoc cooperation
  - Appears to matter in mentoring

