

A Taxonomy of Open-Source Business Models

Online Appendix

Table A.1: Open-source business models from literature review in Iteration 1

Authors \ Concepts	Value Creation	Community	Architecture	Financials	Service and Implementation Model	Licensing	Resources	Business Functions	Market	Usage
Feller et al. (2008)	x	x	x	x						
Rajala et al. (2003)	x		x	x	x					
Charvat et al. (2009)	x			x		x				
Okoli and Nguyen (2015)	x			x		x				
Rajala et al. (2007)	x	x		x			x			
Riehle (2009)	x	x						x		
Laine et al. (2009)	x			x				x		
Munga et al. (2009)	x			x					x	
Seppänen and Helander (2014)	x	x	x	x						
Spijkerman and Jansen (2018)	x	x	x	x						x

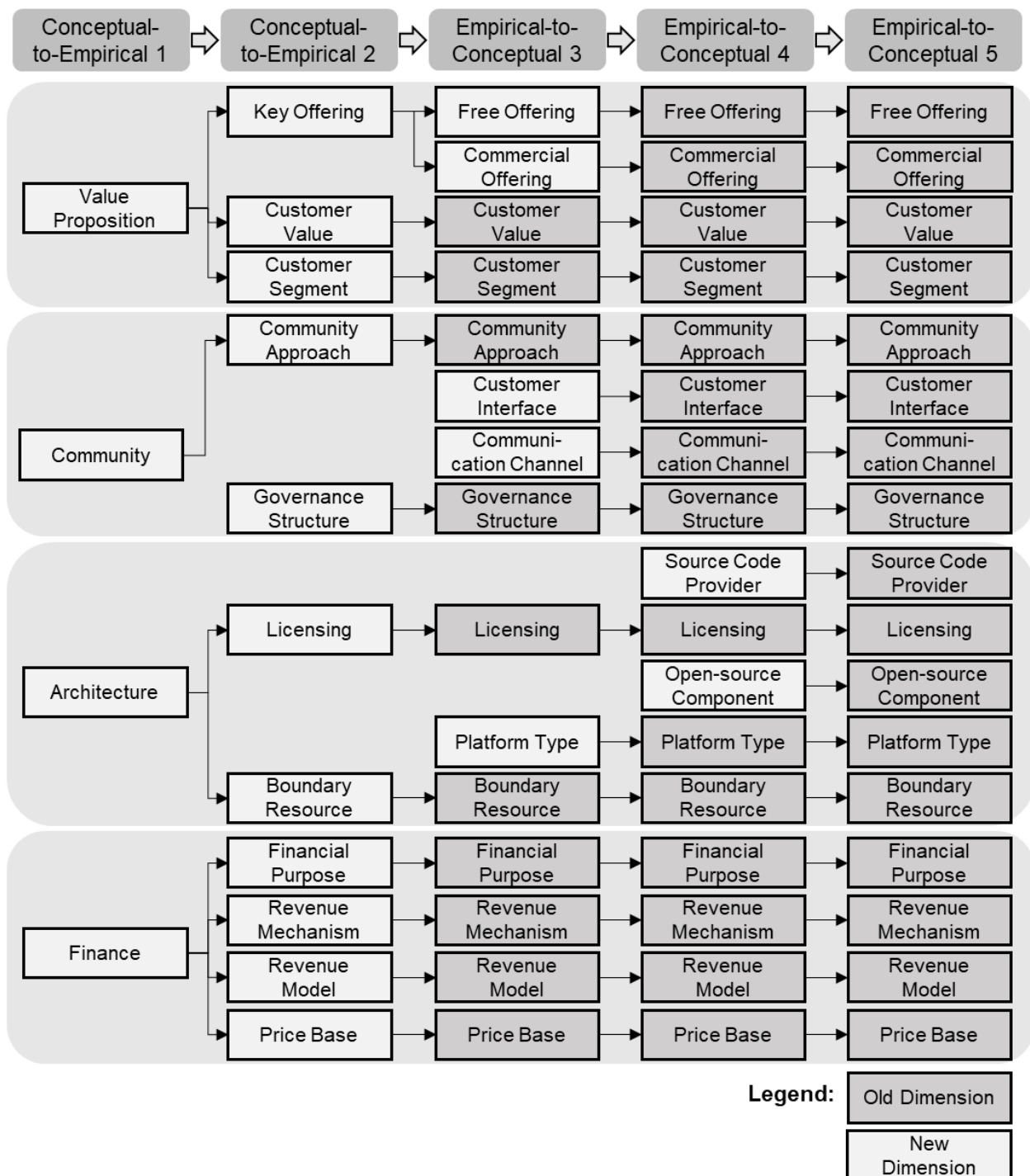


Figure A.1: Overview of the five iterations required to design the taxonomy

Table A.2: Explanation sheet of the taxonomy's dimensions

Dimension/ Characteristics		Definition
Free Offering – which offer is available free of charge? (D₁)		
Components (C₁₁)		Software building blocks (e.g., objects, modules, or functions) that are designed to plug into a larger application framework in order to be a complete product (Sameting 1997).
Software (C₁₂)		Programs written to solve specific problems (Frankenfeld 1993). For example, OSS, open-source apps, or enterprise software.
Platform (C₁₃)		A group of technologies that are used as a base upon that serve to host or develop other applications, processes or technologies OR/AND an intermediary instance that is enabling and controlling transactions between different parties (Nambisan 2017; Schreieck et al. 2016; Tiwana 2015). For example, Marketplaces, Development Platform, Interaction Networks.
(Digital) Infrastructure (C₁₄)		Digital technology that offer communication, collaboration and/or computing capabilities, such as, storage, server, networking, computing capacities or physical data center(Nambisan 2017).
Physical Service (C₁₅)		All services performed directly by a person such as trainings, consulting or personnel support(Hecker 1999).
Data Service (C₁₆)		All services based upon data, e.g., data provision, data conversion, data analytics, or artificial intelligence.(Tammisto and Lindman 2012)
None (C₁₇)		No free offering available.
Commercial Offering – Which offer is chargeable? (D₂)		
Software (C₂₁), Platform (C₂₂), Infrastructure (C₂₃), Physical Service (C₂₅), Data Service (C₂₆)		See above.
Physical Product (C₂₄)		Physical products, such as, hardware, merchandise or smart products(Hecker 1999).
Franchising (C₂₇)		The organization charges other organizations for the legal right to use its brand names and trademarks in creating derivative products and be part of the companies' network(Hecker 1999).
None (C₂₈)		No commercial offering available.
Customer Value – What value is delivered to the costumer? (D₃)		
Functional Value (C₃₁)		The product attributes that help create value, such as cost, quality, reliability, security, and performance(Shanker 2012).
Cost/Sacrifice Value (C₃₂)		The perceived cost/benefit value: The lower the price/effort, the higher the perceived value, e.g., code building blocks or samples(Shanker 2012).
Relationship Value (C₃₃)		The overall customer experience during interactions with the supplier, e.g., service support, delivery performance, personal interactions or integration support(Shanker 2012).
Co-Creation Value (C₃₄)		The value perceived in modifying available code or defining requirements that allow a product to be customized to meet a customer's need, e.g., customization of an ERP-system(Shanker 2012).
Open Source Brand Value (C₃₅)		The value that customers perceive in the open source brand itself. For example, by gaining access to the open source

Dimension/ Characteristics	Definition
	community or by creating partnerships with other companies(Shanker 2012).
Social Value (C₃₆)	The social value that the software offers, e.g., data sovereignty, privacy, or services for the society.
Customer Segment –Which is the customer segment for the offer? (D₄)	
Business (C₄₁)	The main customers are for-profit businesses.
Public Sector (C₄₂)	The main customers are non-profit or governmental organizations.
Academics (C₄₃)	The main customers are academics, e.g., schools or universities.
Consumer (C₄₄)	The main customers are individuals.
Community Approach –Which community approach does the company pursue? (D₅)	
Symbiotic Approach (C₅₁)	The organization pursues an active involvement and participation with the community. The impact of potential decisions on the community is considered, and norms and values are respected. The organization, for example, aligns different interests, provides boundary resources, devote personnel to work in communities and provide learning materials. Both parties profit from the relationship.(Dahlander and Magnusson 2005).
Commensalistic Approach (C₅₂)	The organization is less involved in the community. It searches for useful input from the community and respects its the norms and values but contributes little to further development.. Sometimes personnel, boundary resources or other resources are provided. The organization gains, the community is not affected (negatively or positively)(Dahlander and Magnusson 2005).
Parasitic Approach (C₅₃)	The organization search for useful input without obeying norms, values and rules of the community. Harmful decisions, e.g., closing OSS, are taken without considering the community. The organization gains, the community loses(Dahlander and Magnusson 2005).
Customer Interface –How can the costumer access the product offer? (D₆)	
App-based (C₆₁)	The customer can access the product offer by downloading the application.
Browser-based (C₆₂)	The customer can access the product offer directly on the website.
On-premise (C₆₃)	The customer can access the product offer by downloading and installing the program.
Communication Channel – Through which channel is the organization communicating to the customers? (D₇)	
Mailing List (C₇₁)	The organization is communicating through mailing lists with the community.
Documentation (C₇₂)	The organization provides blogs and documents to transfer knowledge and communicate.
Social Events (C₇₃)	Hackathons, virtual events, or meet-ups are organized to engage with the community.
Own Forum (C₇₄)	The organization provides an own forum on its website to interact with the community. By providing an own forum, the organization can actively form and influence the community.
External Platform (C₇₅)	The organization uses external platforms (e.g., Github, SourceForge) to interact with the community.
Collaboration Control? – How much is the organization controlling the collaboration with the community? (D₈)	
Centralized (C₈₁)	The control and decision rights are not shared with third parties. Every pull-request and decision are controlled by the core developer team(Sharma et al. 2002).

Dimension/ Characteristics	Definition
Balanced (C₈₂)	The control and decision rights are partly shared with third parties. Third-party developer from the community can be part of the core developer team after absolving trainings or proving themselves as valued contributors(Sharma et al. 2002).
Decentralized (C₈₃)	The control and decision rights are shared democratically, e.g., every third-party developer can choose to work on specific tasks and is accepted into the core developer team(Sharma et al. 2002).
Initial Source Code Provider? –Who provides the core of the initial product offer? (D₉)	
Company (C₉₁)	The initial project and core product comes from a company.
Non-Profit Organization (C₉₂)	The initial project and core product comes from a non-profit organization, e.g., a company wraps open source code developed by developed a non-profit organization in its product offering.
Individuals (C₉₃)	The initial project and core product comes from individuals.
Licensing – How are the products licensed? (D₁₀)	
Proprietary License (C₁₀₁)	The source code is not open. The proprietary license restrict the licensees to use, modify, share modifications, or share the software(Välimäki and Oksanen 2005).
Permissive License (C₁₀₂)	The source code is open. The permissive license holds only minimal restrictions on how the software can be used, modified, and redistributed, e.g., MIT license, Apache license or BSD license(Raymond 2001; Välimäki and Oksanen 2005).
Copyleft License (C₁₀₃)	The source code is open. The software can be used, modified, and redistributed with the condition that the same rights be preserved in derivative works, e.g., GPL license (Raymond 2001).
Open-Source Component –Which components are open-source? (D₁₁)	
Complete Product (C₁₁₁)	The complete software is licensed as open source.
Core Component (C₁₁₂)	The core software is licensed as open source.
Complementary Component (C₁₁₃)	Complementary software is licensed as open source, e.g., boundary resources or applications.
None (C₁₁₄)	No product is open source.
Platform Type – Which platform type does the organization provide? (D₁₂)	
Innovation platforms (C₁₂₁)	Extensible code base and a group of technologies as platforms. The code base provides core functions and interfaces that are shared by different modules that interact with each other. Third-party developers can innovate and build applications for the innovation platform (Cusumano et al. 2019; King 2013; Schrieck et al. 2016).
Transaction platform (C₁₂₂)	Platforms that act as intermediaries during transactions between two actors (e.g., customer and supplier). As a third party, the intermediary controls and facilitates the transactions that take place(Cusumano et al. 2019; Schrieck et al. 2016; Tiwana et al. 2010).
Integrated platforms (C₁₂₃)	A platform that is both a transaction platform and an innovation platform (Evans and Gawer 2016).
None (C₁₂₄)	The product offering does not contain a platform.
Boundary Resource – Which boundary resources are provided to involve the user? (D₁₃)	
Development (C₁₃₁)	Program resources or tools that enable the third-party developer to develop and evolve applications; they are also technical boundary resources, e.g., software development kit or debugging tools(Bianco et al. 2014).
Application (C₁₃₂)	Program resources that enable the third-party application to interact with the platform; they are also technical boundary resources, e.g., APIs, REST APIs(Bianco et al. 2014).

Dimension/ Characteristics	Definition
None (C₁₃₃)	No (technical) boundary resources are provided.
Financial Purpose – What is the financial purpose of the organization? (D₁₄)	
Commercial (C₁₄₁)	For-profit companies which aim to earn profit through its product offering. Indicators that the project or organization could be for-profit: Registered company, .com-URL or professional product plans(Allen 2012).
Quasi-commercial (C₁₄₂)	Individuals or organizations asking for donations and offering potentially revenue generating product offerings or advertisement. Indicators, that the project or organization could be for-profit oriented in the future: .com-URL, articles, or professional product plans(Allen 2012).
Non-commercial (C₁₄₃)	Non-profit organizations not seeking for profit. All revenues are used to sustain the project. Indicators that the project or organization could be non-profit: Registered non-profit organizations, .org-URL, mostly volunteer-based project(Allen 2012).
Revenue Mechanism– Which revenue mechanism is pursued by the organization? (D₁₅)	
Direct-sale (C₁₅₁)	The open-source offer is directly sold, e.g., the premium version of open core products(Raymond 2001).
Indirect-sale (C₁₅₂)	The open-source offer is not directly sold but complementary products or services, e.g., (digital) infrastructure, handbooks, smart products or support(Raymond 2001).
Funding (C₁₅₃)	Revenue is generated by funding, e.g., donations, sponsorships, or fundraising.
Revenue Model – Which revenue model is used to generate monetary income? (D₁₆)	
Subscription (C₁₆₁)	The customer must pay a recurring price at regular intervals to access a product. The free offering is time limited .
Freemium (C₁₆₂)	The customer must pay a recurring price at regular intervals to access a product. The free offering is time unlimited .
Fee (C₁₆₃)	The customer must pay, for example, a license fee, up-front fee, or transaction fee.
Pay-per-Use (C₁₆₄)	The customer is paying per consumed resource.
Ads (C₁₆₅)	The revenue is generated through ads.
Passive Income (C₁₆₆)	The revenue is generated through passive income, e.g., shareholding, income from cryptocurrencies.
Financial Support (C₁₆₇)	The revenue is generated through sponsorship, funding, donations or venture capital.
Price Base – On which price base is the income generated? (D₁₇)	
User Entity (C₁₇₁)	The price is based on user entity, e.g., single user, company or team that uses the product.
Time (C₁₇₂)	The price is based on time, e.g., day, month, or year.
Transaction (C₁₇₃)	The price is based on transactions.
Download (C₁₇₄)	The price is based per download.
Resource (C₁₇₅)	The price is based on consumed resources, e.g., server or cloud capacity.
Sponsor (C₁₇₆)	The revenue is based on the sponsor that does not necessarily use the product.

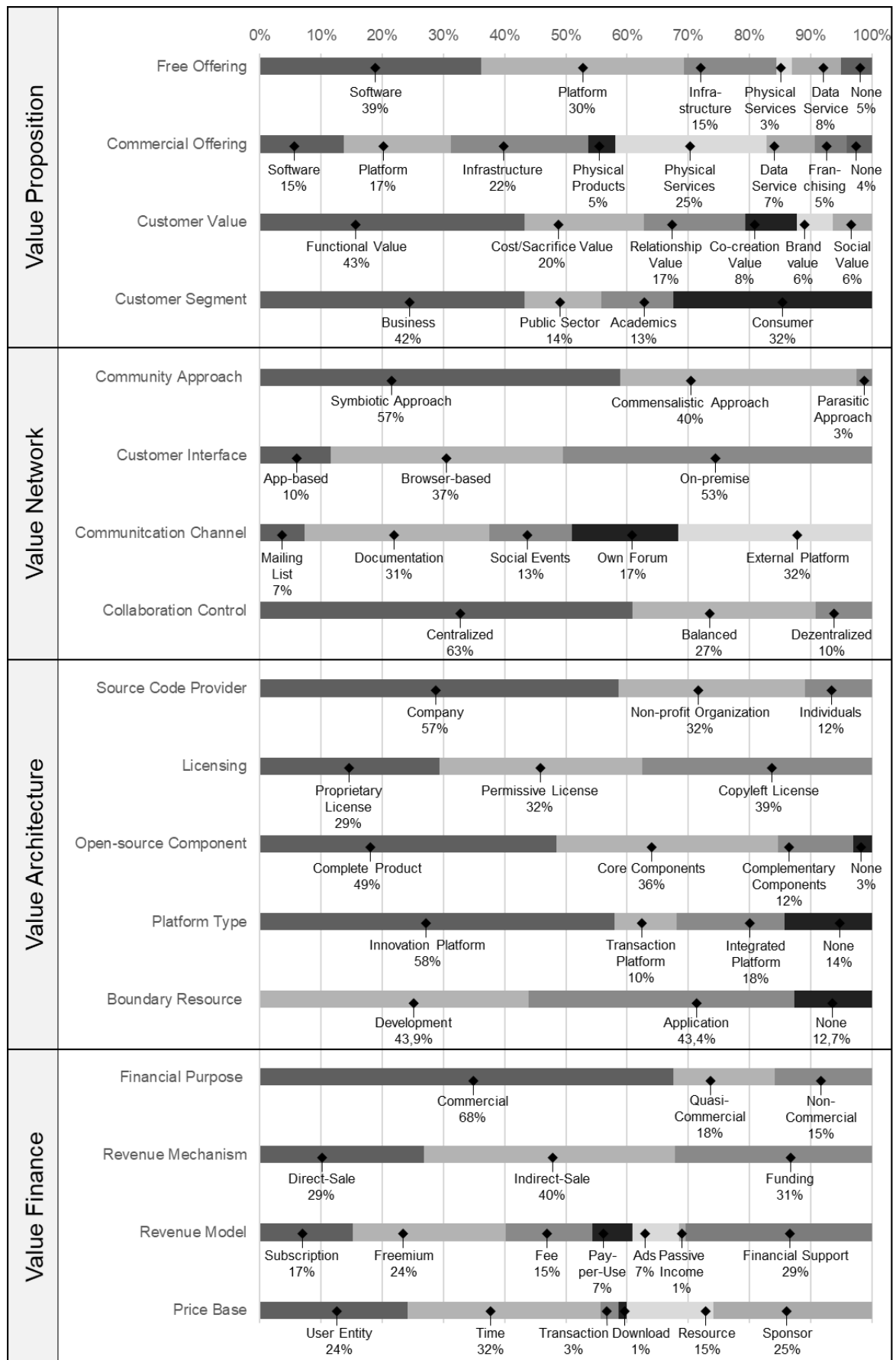


Figure A.2: Distribution of the characteristics per dimension

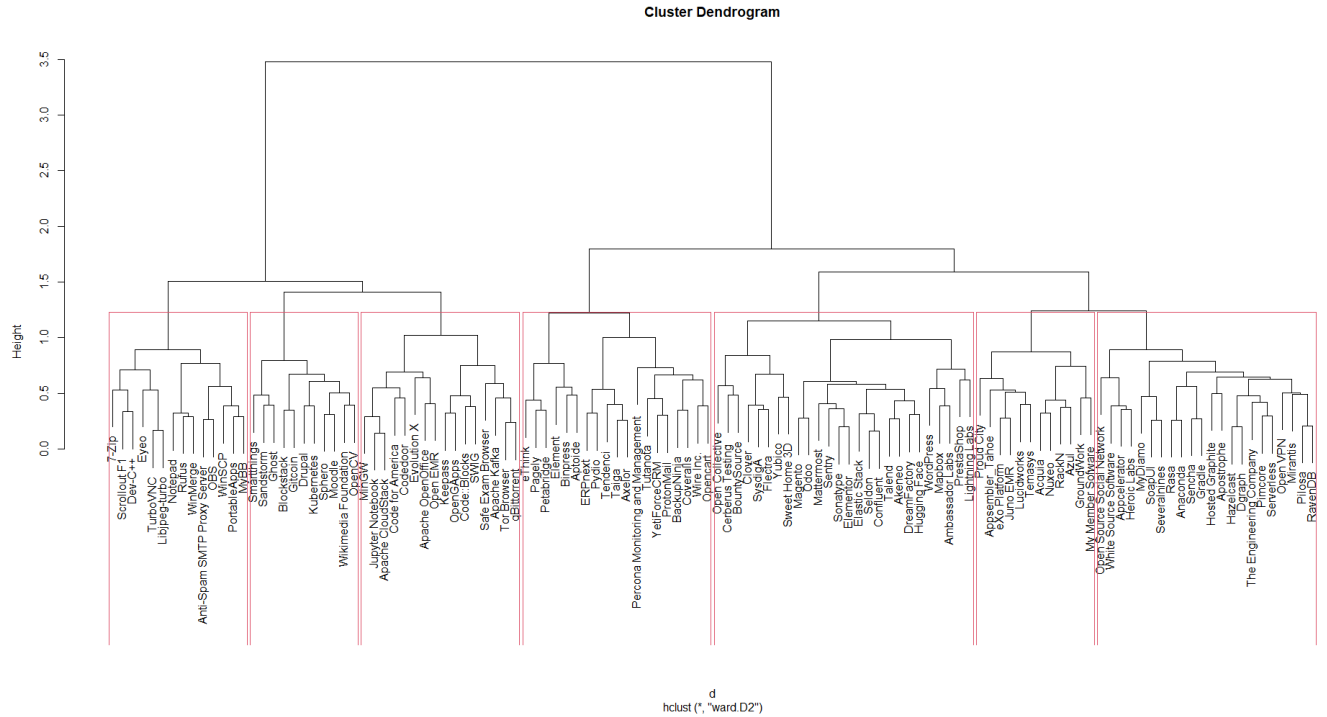


Figure A.3: Visualization of the Ward clustering using a dendrogram

Table A.3: Samples with name of the organization or project, website, and source

Sample	Link	Source
Smartthings	https://www.smartthings.com/	Angellist
Stack	https://www.stacks.co/	Angellist
Code for America	https://www.codeforamerica.org/	Angellist
Binpress	https://www.binpress.com/	Angellist
Magento	https://magento.com/	Angellist
Sencha	https://www.sencha.com/	Angellist
DreamFactory	https://www.dreamfactory.com/	Angellist
Appsembler_Tahoe	https://appsembler.com/tahoe/	Angellist
Elastic Stack	https://www.elastic.co/de/subscriptions	Angellist
WordPress	https://de.wordpress.com/pricing/	Angellist
Wikimedia Foundation	https://wikimediafoundation.org/	Angellist
Appcelerator	https://www.appcelerator.com/pricing/	Angellist
Mapbox	https://www.mapbox.com/pricing/	Angellist
Hazelcast	https://hazelcast.com/pricing/	Angellist

Sample	Link	Source
eThink	http://ethinkeducation.com/	Angellist
Heroic Labs	https://heroiclabs.com/	Angellist
Open Collective	https://opencollective.com/pricing	Angellist
Sentry	https://sentry.io/pricing/	Angellist
Rasa	https://rasa.com/product/pricing/	Angellist
Gradle	https://gradle.com/build-scans/	Angellist
Yubico	https://www.yubico.com/	Angellist
Seldon	https://www.seldon.io/tech/products/	Angellist
Anaconda	https://www.anaconda.com/	Angellist
Confluent	https://www.confluent.io/contact	Angellist
Sysdig	https://sysdig.com/	Angellist
Acquia	https://www.acquia.com	Angellist
Talend	https://www.talend.com/products/pricing-model/	Angellist
PrestaShop	https://www.prestashop.com/de	Angellist
Sphero (früher littleBits)	https://sphero.com/	Angellist
eyeo	https://eyeo.com/	Angellist
Nuxeo	https://www.nuxeo.com/de/	Angellist
Ambassador Labs	https://www.getambassador.io/	Angellist
Clover	https://www.clover.com/	Angellist
Hugging Face	https://huggingface.co/	Angellist
Sonatype	https://de.sonatype.com/	Angellist
Lightning Labs	https://lightning.engineering/	Angellist
Akeneo	https://www.akeneo.com/	Angellist
Pilosa	https://www.pilosa.com/	Angellist
RackN	https://rackn.com/	Angellist
Mirantis	https://www.mirantis.com/	Angellist
Codedoor	https://codedoor.com/	Angellist
Open VPN	https://openvpn.net/	Angellist
Dgraph	https://dgraph.io/	Angellist

Sample	Link	Source
Gitcoin	https://gitcoin.co/	Angellist
Aptoid	https://en.aptoide.com/	Angellist
Lucidworks	https://lucidworks.com/	Angellist
Pagely	https://pagely.com/eu/	Angellist
Petabridge	https://petabridge.com/	Angellist
Sandstorm	https://sandstorm.io/	Angellist
MinGW	http://www.mingw.org/	Sourceforge
Apache OpenOffice	https://www.openoffice.org/	Sourceforge
PortableApps	https://portableapps.com/	Sourceforge
Scrollout F1	http://www.scrolloutf1.com/rbl	Sourceforge
WinSCP	https://winscp.net/eng/index.php	Sourceforge
Rufus	https://rufus.ie/	Sourceforge
Anti-Spam SMTP Proxy Server	http://www.thockar.com/assp-home/	Sourceforge
Keepass	https://keepass.info/	Sourceforge
Sweet Home 3D	http://www.sweethome3d.com/	Sourceforge
Safe Exam Browser	https://www.safeexambrowser.org/news_en.html	Sourceforge
Code::Blocks	http://www.codeblocks.org/	Sourceforge
Dev-C++	http://orwelldevcpp.blogspot.com/ ; http://www.bloodshed.net/	Sourceforge
Tor Browser	https://www.torproject.org/download/	Sourceforge
qBittorrent	https://www.qbittorrent.org/	Sourceforge
Hosted Graphite	https://www.hostedgraphite.com/	Sourceforge
RavenDB	https://ravendb.net	Sourceforge
YetiForceCRM	https://yetiforce.com	Sourceforge
Cerberus Testing	https://cerberus-testing.com	Sourceforge
Open Source Social Network	/www.opensource-socialnetwork.org/	Sourceforge
TurboVNC	https://turbovnc.org/	Sourceforge

Sample	Link	Source
Libjpeg-turbo	https://libjpeg-turbo.org/	Sourceforge
Evolution X	https://evolution-x.org/#/	Sourceforge
OpenGApps	https://opengapps.org/	Sourceforge
7-Zip	https://www.7-zip.org/	Sourceforge
OpenCV	https://opencv.org/	Sourceforge
WinMerge	https://winmerge.org/	Sourceforge
Notepad	https://notepad-plus-plus.org/	Sourceforge
GroundWork	https://www.gwos.com	Sourceforge
Tendenci	https://www.tendenci.com	Sourceforge
Percona Monitoring and Management	https://www.percona.com	Sourceforge
Elementor	https://elementor.com/pricing/	Sourceforge
Moodle	https://moodle.com	Sourceforge
ProtonMail	https://protonmail.com/de/	Sourceforge
Wire Inc.	https://wire.com/de/pricing/	Sourceforge
Odoo	https://www.odoo.com/de_DE/	Sourceforge
My Member Software	https://www.mymembersoftware.com/en/	Sourceforge
Mattermost	https://mattermost.com	Sourceforge
ERPnext	https://erpnext.com	Sourceforge
Drupal	https://www.drupal.org	Sourceforge
BackupNinja	https://backup.ninja	Sourceforge
SoapUI	https://www.soapui.org/downloads/soapui/	Sourceforge
Element	https://element.io	Sourceforge
Jupyter Notebook	https://jupyter.org	Sourceforge
Apache CloudStack	https://cloudstack.apache.org/	Sourceforge
Tutanota	https://tutanota.com/de/	Sourceforge
Taiga	https://www.taiga.io	Sourceforge
Flectra	https://flectrahq.com	Sourceforge
Apostrophe	https://apostrophecms.com	Sourceforge

Sample	Link	Source
Kubernetes	https://kubernetes.io/de/	Sourceforge
Axelor	https://www.axelor.com/service-company/	Sourceforge
Opencart	https://www.opencart.com	Sourceforge
eXo Platform	https://www.exoplatform.com/technology/	Sourceforge
Juno EMR	https://www.junoemr.com/login?login=no_instance	Sourceforge
Pimcore	https://pimcore.com	Sourceforge
Open EMR	https://www.open-emr.org	Sourceforge
Apache Kafka	https://kafka.apache.org	Sourceforge
MyDiamo	https://mydiamo.com	Sourceforge
Severalnines	https://severalnines.com	Sourceforge
MyBB	https://mybb.com/	Sourceforge
Ghost	https://ghost.org/	Angellist
Temasys	http://www.temasys.io/	Angellist
BountySource	https://www.bountysource.com/	Angellist
Serverless	https://www.serverless.com/	Angellist
Pydio	https://pydio.com/	Angellist
Coveralls	https://coveralls.io/	Angellist
White Source Software	https://www.whitesourcesoftware.com/	Angellist
Proud City	https://proudcity.com/	Angellist
SWIG	http://www.swig.org/	Sourceforge
OBS	https://obsproject.com/	Sourceforge

References

Allen, J. P. (2012). Democratizing Business Software: Small Business Ecosystems for Open Source Applications. *Communications of the Association for Information Systems*, 30(28), 483–496.
doi:10.17705/1CAIS.03028

- Bianco, V., Myllärniemi, V., & Raatikainen, M. (2014). The Role of Platform Boundary Resources in Software Ecosystems: A Case Study. *Proceedings - Working IEEE/IFIP Conference on Software Architecture 2014, WICSA 2014*. doi:10.1109/WICSA.2014.41
- Charvat, K., Cerba, O., Jezek, J., Frymi, J., & Pospisil, M. (2009). Open Source Business Models and Strategies. In *XV Conference "Information systems in agriculture and forestry"* Prague: Czech Republic.
- Cusumano, M. A., Gawer, A., & Yoffie, D. B. (2019). *The business of platforms: Strategy in the age of digital competition, innovation, and power* (First edition). New York, NY: Harper Business.
- Dahlander, L., & Magnusson, M. G. (2005). Relationships between open source software companies and communities: Observations from Nordic firms. *Research Policy*, 34(4), 481–493. doi:10.1016/j.respol.2005.02.003
- Evans, P., & Gawer, A. (2016). The Rise of the Platform Enterprise: A Global Survey. <http://eprints.surrey.ac.uk/id/eprint/811201>.
- Feller, J., Finnegan, P., & Hayes, J. (2008). Delivering the Whole Product. *Journal of Database Management*, 19(2), 95–108. doi:10.4018/jdm.2008040105
- Frankenfeld, F. M. (1993). Basics of Computer Hardware and Software. *American Journal of Health-System Pharmacy*, 50(4), 717–724. doi:10.1093/ajhp/50.4.717
- Hecker, F. (1999). Setting up shop: The business of open-source software. *IEEE Software*, 16(1), 45–51.
- King, S. P. (2013). Two-Sided Markets. *Australian Economic Review*, 46(2), 247–258. doi:10.1111/j.1467-8462.2013.12020.x
- Laine, M., Rönkkö, M., & Valtakoski, A. (2009). Software Firm Business Models with Virtual Communities. *15th Americas Conference on Information Systems 2009, AMCIS 2009*, 8.
- Munga, N., Fogwill, T., & Williams, Q. (2009). The adoption of open source software in business models. In *Proceedings of the 2009 Annual Conference of the South African Institute of Computer Scientists and Information Technologists*. Vanderbijlpark.

- Nambisan, S. (2017). Digital Entrepreneurship: Toward a Digital Technology Perspective of Entrepreneurship. *Entrepreneurship Theory and Practice*, 41(6), 1029–1055.
doi:10.1111/etap.12254
- Okoli, C., & Nguyen, J. (2015). Business Models for Free and Open Source Software: Insights from a Delphi Study. In *Proceedings of the 21st Americas Conference on Information Systems* Puerto Rico.
- Rajala, R., Nissilä, J., & Westerlund, M. (2007). Revenue Models in the Open Source Software Business. In K. St.Amant & B. Still (Eds.), *Handbook of Research on Open Source Software* (pp. 541–554). IGI Global.
- Rajala, R., Rossi, M., & Tuunainen, V. (2003). A framework for analyzing software business models. In *Proceedings of the 11th European Conference on Information Systems* Naples: Italy.
- Raymond, E. S. (2001). *The cathedral and the bazaar: Musings on Linux and open source by an accidental revolutionary* (Rev. ed.). *Safari Books online*. Beijing: O'Reilly. Retrieved from <http://proquest.tech.safaribooksonline.de/0596001088>
- Riehle, D. (2009). The Commercial Open Source Business Model. In *Proceedings of the 15th Americas Conference on Information Systems* . San Francisco. Retrieved from https://www.researchgate.net/publication/220890528_The_Commercial_Open_Source_Business_Model
- Sametinger, J. (1997). *Software engineering with reusable components: With 26 tables*. Berlin: Springer.
- Schreieck, M., Wiesche, M., & Krcmar, H. (2016). Design and Governance of Platform Ecosystems – Key Concepts and Issues for Future Research. In *Proceedings of the 24th European Conference on Information Systems* . Istanbul: Turkey.
- Seppänen, M., & Helander, N. (2014). Creating Value through Business Models in Open Source Software. *International Journal of Open Source Software and Processes*, 5(2), 40–54.
doi:10.4018/ijossp.2014040102

- Shanker, A. (2012). A Customer Value Creation Framework for Businesses That Generate Revenue with Open Source Software. *Technology Innovation Management Review*, 2, 18–22.
doi:10.22215/timreview/534
- Sharma, S., Sugumaran, V., & Rajagopalan, B. (2002). A framework for creating Hybrid open-source software communities. *Information Systems Journal*, 12(1), 7–25. doi:10.1046/j.1365-2575.2002.00116.x
- Spijkerman, Z., & Jansen, S. (2018). The open source software business model blueprint: A comparative analysis of 10 open source companies. In *SiBW*.
- Tammisto, Y., & Lindman, J. (2012). Definition of Open Data Services in Software Business. In W. van der Aalst, J. Mylopoulos, M. Rosemann, M. J. Shaw, C. Szyperski, M. A. Cusumano, . . . N. Venkatraman (Eds.), *Lecture Notes in Business Information Processing. Software Business* (pp. 297–303). Berlin, Heidelberg: Springer Berlin Heidelberg.
- Tiwana, A. (2015). Evolutionary Competition in Platform Ecosystems. *Information Systems Research*, 26(2), 266–281. doi:10.1287/isre.2015.0573
- Tiwana, A., Konsynski, B., & Bush, A. A. (2010). Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics. *Information Systems Research*, 21(4), 675–687. doi:10.1287/isre.1100.0323
- Välimäki, M., & Oksanen, V. (2005). The impact of free and open source licensing on operating system software markets. *Telematics and Informatics*, 22(1-2), 97–110.
doi:10.1016/j.tele.2004.06.008