



# Classifying Venture Capital Backed Open Source Software Startups Using Publicly Available Information

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# Objective

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- Classify VC funded OSS startups in terms of the information on their market offers and businesses that is available online
- An OSS startup refers to a company that:
  - was established after 2000
  - has no public offering
  - is not a subsidiary of a parent company
  - generates its revenue through market offers that rely on OSS
- A VC funded OSS startup refers to an OSS startup that has received institutional financing from one or more independent VC firms and bank-based VC firms

# Deliverables

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- Provide a classification of VC funded OSS startups using information published on their websites
- Observations about the market offers of VC funded OSS startups useful to:
  - top management teams
  - investors
  - academics
  - entrepreneurs

# Relevance

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## Who cares

Top management teams of OSS startups

Canadian VC investors

Academics

Entrepreneurs

## Why

- Know the types of market offers which VC backed companies develop and sell
- Learn the extent to which venture capitalists in the United States invest in OSS startups
- Provide a “how to” approach to mine information on companies’ websites
- Use the results of the Factor Analysis as a template when deciding how to
  - structure their portfolios of products and services
  - add value to the external communities on which they depend

# Contribution

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- Provide evidence that VC funded OSS startups seek to concurrently add value to their customers as well as the external communities
- Categorize the market offers from VC funded OSS startups
- Contribute new insights about the breakdown of the market offers from VC funded OSS startups
  - Company clusters in terms of the same types of market offers
  - Types of market offers provided by most of these companies

# Literature review

Stream	Key highlights of the stream	Key references
VC investment in OSS companies	<ul style="list-style-type: none"> <li>• VC interests in OSS companies</li> <li>• Ways to evaluate OSS startups</li> </ul>	Aslett (2007), Aslett (2008), Blau (2006), Byfield (2008), Callahan and Charbonneau (2003), Callahan and Muegge (2002), Callow and Larsen (2003), Cook (2005), Haapanen (2007), LaMonica (2005), Pienaar (2007), Puhakka and Jungman (2005), Roblimo (2006), Sterne and Herring (2006), Wood (2005)
Websites as corporate identities	<ul style="list-style-type: none"> <li>• Corporate identity</li> <li>• Corporate identities demonstrated by websites</li> </ul>	Balmer (2001), Balmer and Soenen (1999), Berthon et al. (1996), Birkigt and Stadler (1986), Hicks et al. (2006), Opoku (2005), Pollach (2005), Schmidt (1995), Topalian (2003)
Market offers based on OSS	<ul style="list-style-type: none"> <li>• OSS market offers</li> <li>• Ways companies integrated OSS into their market offers</li> </ul>	Alam (2006), Koenig (2004), Kotler and Turner (1995), Levitt (1980), Pienaar (2007)
Open source community development	<ul style="list-style-type: none"> <li>• Rationales for open source community</li> <li>• Community-based innovation</li> <li>• Open source community</li> <li>• Relationships between OSS companies and their communities</li> </ul>	Chesbrough and Appleyard (2007), Dahlander and Magnusson (2005), e-Cology Corporation (2003), Rothfuss (2002), Ueda (2006), von Hippel (2005), von Hippel and von Krogh (2003), West and Gallagher (2006), Wallace (2006), Yang (2005)
Web-based content mining	<ul style="list-style-type: none"> <li>• Content analysis of websites</li> <li>• Content mining approaches</li> </ul>	Hicks et al. (2006), Ho (1997), Jo and Jung (2005), Kent et al. (2003), Liu et al. (1997), Marston (2003), Perry and Bodkin (2000), Pollach (2003), Weiss (2005)

# Lessons learned

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- Need to examine the market offers of VC funded OSS startups
- Articulate corporate identities from websites
- Lack of content analysis research on the websites of OSS companies
- Self-sustaining OSS communities rarely emerge spontaneously
- Uncertainties in the VC valuation of OSS startups

# Research method

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- Unit of analysis: a VC funded startup that sells products and/or services that rely on OSS projects
- Study period: January, 2000 to January, 2008
- The research method used in this research is based on the method used by Hicks et al. (2006)

# Research steps

Steps in research method	Activities
1. Get started	<ul style="list-style-type: none"><li>• Define research objective</li></ul>
2. Select sample	<ul style="list-style-type: none"><li>• Set criteria for sample selection</li><li>• Identify and verify the websites of OSS startups</li></ul>
3. Collect data	<ul style="list-style-type: none"><li>• Select web pages used to develop keywords</li><li>• Identify a list of potentially informative keywords</li><li>• Acquire data in terms of the frequency of occurrence of these keywords on the websites</li><li>• Finalize the list of keywords</li></ul>
4. Analyze data	<ul style="list-style-type: none"><li>• Use Factor Analysis to analyze data</li><li>• Interpret the factors that emerged from the Factor Analysis</li></ul>
5. Discuss results	<ul style="list-style-type: none"><li>• Cluster companies in terms of the factors</li><li>• Compare the results with those in the literature</li></ul>

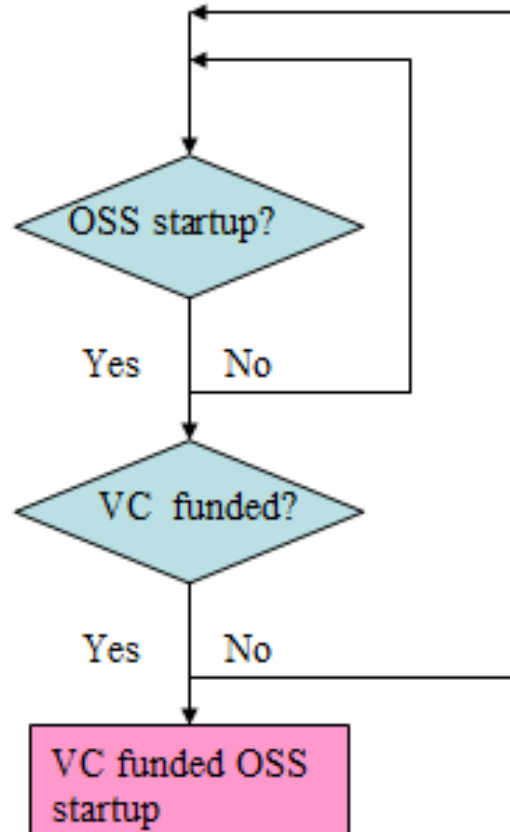
# Sample selection criteria

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- Company was established in North America after January 1, 2000
- Company was funded by one or more VCs
- Company has no public offering
- Company is not a subsidiary of a parent company
- Company provides market offers that rely on one or more OSS projects
- Company's website has more than ten pages and it is in English
  - Small websites with less than 10 pages in size could produce outliers that highly affect Factor Analysis (Hicks et al., 2006)

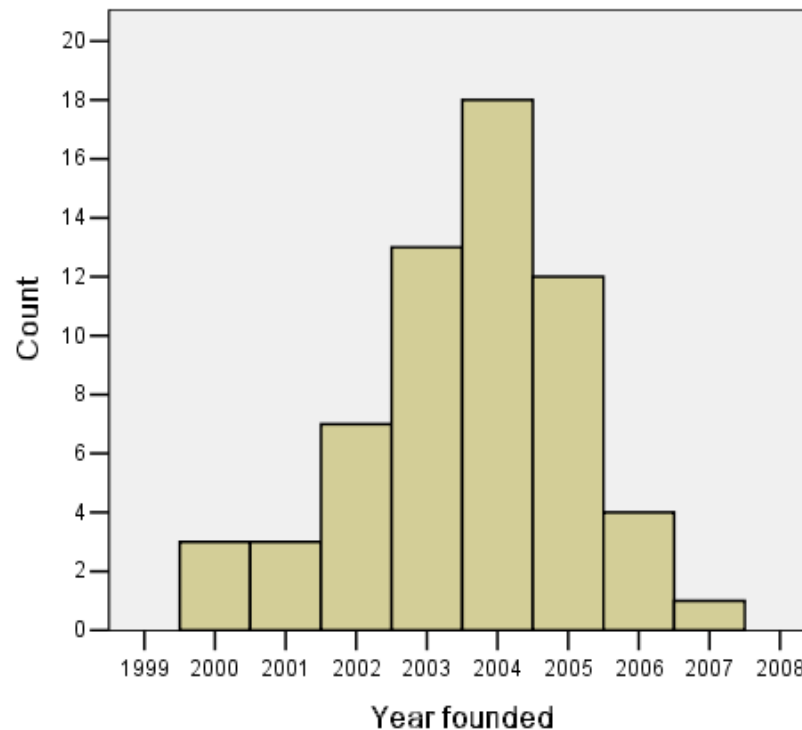
# Diagram of flow

- Use Google search utility to identify VC funded OSS startups and compile a database of these firms



# Sample overview

- 61 VC funded OSS startups
- More than half of the companies in the sample (n=43; 70.5%) were established in 2003, 2004 and 2005
- All companies in the sample were founded in the United States



# Collect data

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- Keyword development
  - Identify a list of potential keywords
  - Verify the list of potential keywords
  - Boolean strings consistent with the requirements of the Google search utility were adopted
    - Uppercase OR between two terms to find pages that include either of them
    - Uppercase AND between two terms to find pages that include all of them
    - Quotation marks around terms to search exact phrases
- Website search and data acquisition
  - Data sources: websites of the VC funded OSS startups
  - Use the Google search engine to develop a firm-by-keyword matrix
  - Use the matrix to record the frequency of occurrence of each keyword on each company's website

# Descriptive statistics of data

- 45 keywords were identified
  - product OR application, solution, product AND performance, service AND support, package OR packaging, accessory OR accessories, “open source” AND project, project, consult OR consulting, support, testing OR training, host OR hosting, subscription, “commercial license” OR “proprietary software”, content, “complementary content”, incorporate OR incorporation, module OR modular, integration OR integrate, component, hardware, Interoperability AND hardware, software, input, platform, peripheral equipment, network infrastructure, community, partner, discussion OR forum, blog, wiki, eco OR ecosystem, “user groups” OR “user group”, “mailing list”, “tracking tool”, org OR organization, delivery, download, channel, upgrade OR update, account AND register, “shopping cart”, buy OR purchase AND online, login OR “sign in”
- Variables for the keywords were transformed by the number of total pages of the firms’ websites
  - For example, for the startup Coupa Software, the hit count of the keyword “product OR application” was transformed as follows:
$$18 / 42 = 0.43$$
    - 18: the hit count of the keyword “product OR application”
    - 42: the total number of pages of the website

# Analyze data

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- Use SPSS to analyze the data
- Factor Analysis was used to analyze the data
  - Alpha Extraction was used
  - Varimax Rotation was used
  - Factors with eigenvalues greater than 1.0 were retained
  - Coefficients over 0.40 were displayed and retained
  - Keywords were dropped
    - if they had zero variance
    - if they were used infrequently and the value of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy was less than 0.60
    - if the value of Kaiser-Meyer-Olkin Measure of Sampling Adequacy increased after they were dropped

# Factor Analysis

- Of the original 45 variables, 19 were used in the Factor Analysis
- Subject (firm) to item (keyword) ratio (61/19) was more than 3
- Commonalities for the variables used in the Factor Analysis with Alpha Factoring as the extraction method:

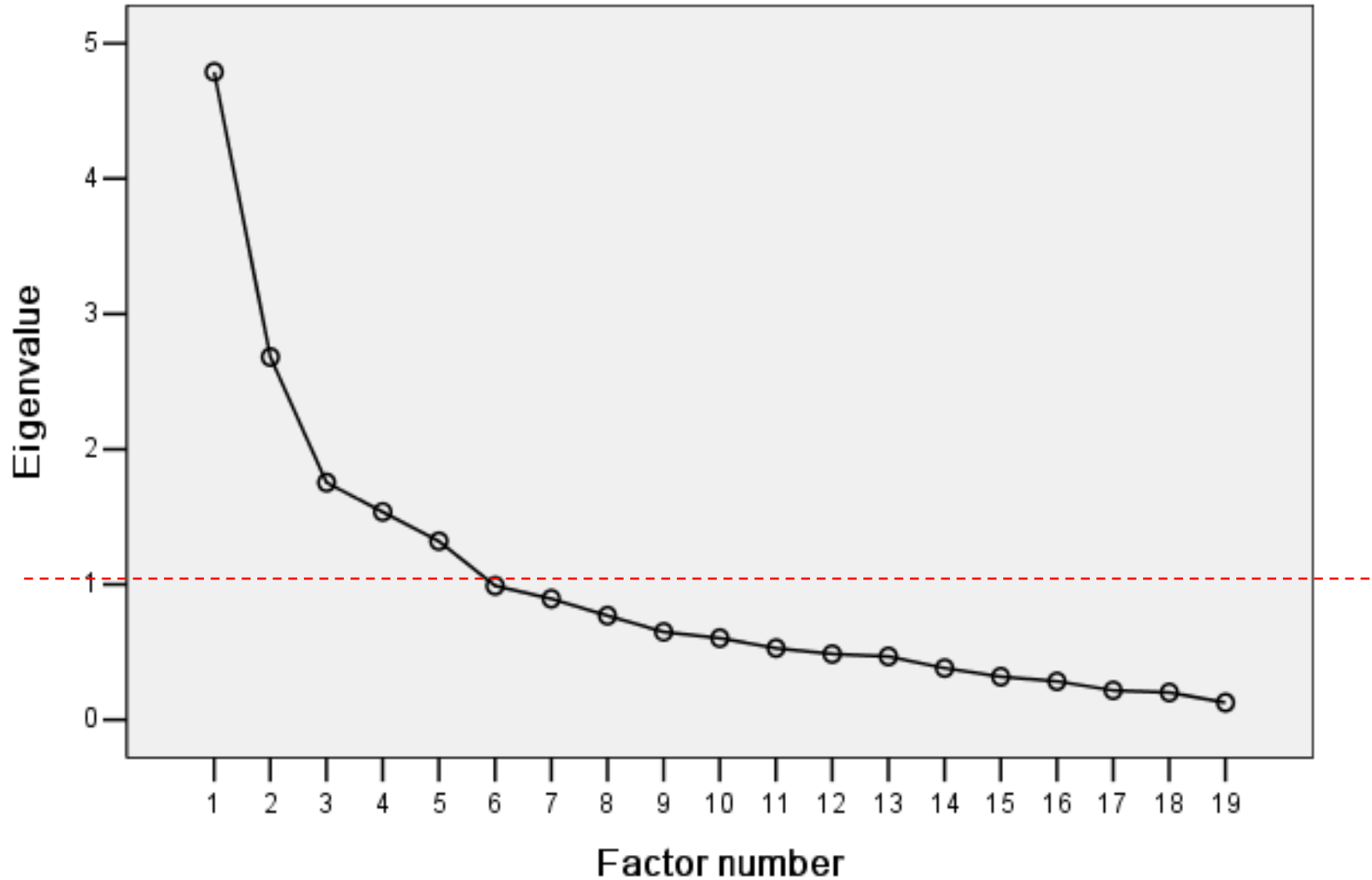
<b>NO.</b>	<b>Transformed variable</b>	<b>Initial</b>	<b>Extraction</b>
1	product OR application	0.715	0.703
2	solution	0.523	0.342
3	service AND support	0.460	0.458
4	"open source" AND project	0.433	0.397
5	consult OR consulting	0.669	0.562
6	testing OR training	0.735	0.863
7	"commercial license" OR "proprietary software"	0.456	0.350
8	integration OR integrate	0.638	0.579
9	hardware	0.464	0.514
10	software	0.649	0.667
11	platform	0.612	0.611
12	community	0.503	0.685
13	partner	0.537	0.435
14	blog	0.399	0.412
15	wiki	0.343	0.381
16	discussion OR forum	0.378	0.358
17	org OR organization	0.301	0.394
18	content	0.376	0.407
19	interoperability AND hardware	0.537	0.527

# Kaiser-Meyer-Olkin Measure of Sampling Adequacy

- Pass the default Kaiser-Meyer-Olkin Measure of Sampling Adequacy, with a value of 0.686
- Bartlett's Test of Sphericity is statistically significant

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.686
Bartlett's Test of Sphericity	Approx. Chi-Square	432.120
	df	171
	Sig.	.000

# Five factors with eigenvalues greater than 1.0



# Total variance explained

- 50.7% of total variance was explained by the five factors

Factor	Rotation sums of squared loadings		
	Total	% of Variance	Cumulative %
1	2.920	15.3	15.3
2	2.835	14.9	30.2
3	1.419	7.5	37.7
4	1.286	6.8	44.5
5	1.184	6.2	50.7

# Results of the Factor Analysis

Interpretation	Transformed variable	Factor				
		1	2	3	4	5
Factor 1 Sell products or applications that integrate OSS with proprietary software or hardware	10. software	.738				
	19. interoperability AND hardware	.704				
	11. platform	.659				
	9. hardware	.634				
	1. product OR application	.627	.419			
	2. solution	.492				
Factor 2 Provide consulting, training or testing services anchored around OSS	6. testing OR training		.922			
	5. consult OR consulting		.717			
	8. integration OR integrate		.640			
	13. partner		.524			
Factor 3 Provide support services and commercial licenses based on OSS projects	17. org OR organization			.603		
	4. "open source" AND project			.549		
	3. service AND support			.477		
	7. "commercial license" OR "proprietary software"			.413		
Factor 4 Community development through blog and wiki	14. blog				.633	
	15. wiki				.584	
Factor 5 Community development through forums	12. community					.721
	16. discussion OR forum					.572

# Summary of the results applied to the 61 VC funded OSS startups

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- Organize and code the 61 VC funded OSS startups in terms of the results of the Factor Analysis
  - Examine each company to identify its market offer related to Factors 1, 2 or 3
  - Examine each company to identify how it support community development using methods associated with Factors 4 or 5
  - For example, Devicescape was coded as **15**
    - Code denoted **1**: integrate OSS with hardware to create security applications for Wi-Fi devices
    - Code denoted **5**: has a community forum to enable developers to post questions and participate in discussions with other community members

# Companies that have the same code

Code	Number of companies	Percent
1	7	11.5%
2	4	6.6%
3	4	6.6%
4	0	0
5	0	0
12	2	3.3%
13	3	4.9%
15	2	3.3%
25	1	1.6%
35	4	6.6%
125	4	6.6%
134	1	1.6%
135	1	1.6%
235	11	18%
245	5	8.2%
1235	1	1.6%
1345	2	3.3%
2345	9	14.7%
Total	61	100%

# Discussion of results

- Interpret the factors
  - Five significant factors (i.e., eigenvalues > 1.0) emerged from the Factor Analysis
  - Factors 1, 2 and 3 refer to market offers of VC funded OSS startups
  - Factors 4 and 5 refer to community development

	<b>Factor represents</b>
<b>Factor 1</b>	Products or applications that integrate OSS with proprietary software or hardware
<b>Factor 2</b>	Consulting, training or testing services anchored around OSS
<b>Factor 3</b>	Support services and commercial licenses based on OSS projects
<b>Factor 4</b>	Community development through content exchange
<b>Factor 5</b>	Community development through communication

# Company clusters

- VC funded OSS startups grouped using the codes
  - 20 companies (33% of the sample) are included in the two clusters denoted **235** and **2345**
    - sell consulting, training and testing services
    - support services and commercial licenses
    - provide community support
  - 23 companies (38% of the sample) sell products and applications
    - 7 companies (11% of the sample), in the cluster denoted **1**, solely sell products and applications
    - 16 companies (27% of the sample), in the clusters denoted **12**, **13**, **15**, **125**, **134**, **135**, **1235**, and **1345**, also sell services or develop communities
  - Clusters **4** and **5** do not exist
  - Of the 61 companies in the sample, 52 sell services (85%)
    - Of the 52 companies that sell services, 41 also provide community development

# Compare with Alam's market offers

- Factors 1, 2 and 3 refer to four types of market offers identified by Alam (2006)
  - products/applications
  - training and testing services
  - support services
  - commercial licenses
- Two types of market offers load on Factor 3
- Hosting and content services are not mainstream market offers for VC funded OSS startups

Identified by both Alam (2006) and results of the Factor Analysis	Identified by Alam (2006) and not by the results of the Factor Analysis
<ul style="list-style-type: none"><li>▪ Factor 1: Products or applications</li><li>▪ Factor 2: Consulting, training and testing services</li><li>▪ Factor 3: Support services and commercial licenses</li></ul>	<ul style="list-style-type: none"><li>▪ Hosting and content services</li><li>▪ Subscription services</li></ul>

# Compare with Alam's ways to integrate OSS

- No matter how extensive OSS was integrated with the proprietary assets, OSS contributed significantly to the market offers

Identified by both Alam (2006) and results of the Factor Analysis	Identified by Alam (2006) and not by the results of the Factor Analysis
<p>Factor 1:</p> <ul style="list-style-type: none"> <li>▪ Comprehensive-Yes</li> <li>(vii) OSS is integrated with proprietary software &amp; hardware to create a product or application</li> <li>(ix) The company uses OSS to seed demand for the company's proprietary application</li> </ul>	<ul style="list-style-type: none"> <li>▪ Minimal-No</li> <li>(i) OSS is used as one of the components to the network that delivers the hosting and content services</li> </ul>
<p>Factor 2:</p> <ul style="list-style-type: none"> <li>▪ Minimal-Yes</li> <li>(ii) OSS is used to anchor training or testing services</li> </ul>	<ul style="list-style-type: none"> <li>▪ Comprehensive-No</li> <li>(vi) OSS is integrated with proprietary software or hardware into an interface module that is a small part of the product</li> </ul>
<p>Factor 3:</p> <ul style="list-style-type: none"> <li>▪ Minimal-Yes</li> <li>(iii) The company uses OSS projects it established to create attractive market offers</li> <li>(iv) The company integrates software from OSS projects established by others and proprietary software from other companies into a stack, adds advanced functionalities such as management capabilities to the software, perform tests, and certify the integrated software</li> <li>(v) The company incorporates OSS from partner companies, and uses commercial and trademark licenses as its market offer</li> </ul>	<ul style="list-style-type: none"> <li>▪ Comprehensive-Yes</li> <li>(viii) The company integrates OSS with network infrastructure to provide subscription services</li> <li>(x) The company integrates OSS with other complementary products to work together as a system; OSS community develops complementary content that is required by the software</li> </ul>

# Importance of wiki, blog and forums

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- Factors 4 and 5 refer to community development through content exchange and communication
- By using wikis, blogs and forums, the OSS companies can create and transfer community values to themselves and their customers
  - Lower the cost of software development
  - Reduce the cost and risk for customers
  - Help companies build their brands
  - Help companies increase their market share

# Conclusions (1)

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- VC funded OSS startups seek to concurrently add value to their customers as well as the communities
- Market offers of VC funded OSS startups can be categorized into three groups:
  - products and applications
  - consulting, training and testing services
  - commercial licenses and support
- A greater number of VC funded OSS startups sell services than products and applications; most startups that sell products or applications, also sell services

# Conclusions (2)

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- Community growth is important to the market offers of VC funded OSS startups
- Factors 1, 2 and 3 refer to four of the six types of market offers identified by Alam (2006)
- Support Alam's (2006) classification of the ways companies integrate OSS into market offers

# Limitations

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- Rely on secondary sources of data
- Depend on the predefined keywords
- Only included VC funded OSS startups established in the United States

# Suggestions for future research

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- Examine the relationship between the market offers of VC funded OSS startups and the size of the developer community
- Researchers can compare market offers across different geographical areas
- Use case studies to examine how VC funded companies create, appropriate, and expand value

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