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# Effect on Business Growth by Utilization and Contribution of Open Source Software in Japanese IT Companies

Tetsuo Noda<sup>1</sup>, Terutaka Tansho<sup>1</sup>, and Shane Coughlan<sup>2</sup>

<sup>1</sup> Shimane University

{nodat@soc.shimane-u.ac.jp, tansho@riko.shimane-u.ac.jp}

<sup>2</sup> Founder at Opendawn, Visiting Researcher at Shimane University and Executive Director / Vice-President Far East at OpenForum Europe  
{shane@opendawn.com}

**Abstract.** The expanded use of Open Source Software (OSS), and the expansion of the market caused by this adoption has led to a corresponding increase in the number of businesses acting as stakeholders in the field. Some of these are pure users of OSS technology but a great number are developers of such technology, and can be understood to have a substantial investment in this paradigm. It is reasonable to assume that such businesses are rational actors, and that their investment or contribution to the field implies a positive economic benefit either currently obtained or assumed as a return in the future. This paper analyzes how OSS affects Japanese IT companies' business growth both through simple use and by deeper engagement as a stakeholder in OSS community. This is the first time that such a link between the utilization of OSS and economic growth has been explored in the context of Japan, and it can hopefully lay a foundation for further study regarding the real economic value of this approach to software.

## 1 Introduction

The expanded use of Open Source Software (OSS), and the expansion of the market caused by this adoption has led to a corresponding increase in the number of businesses acting as stakeholders in the field. Some of these are pure users of OSS technology but a great number are developers of such technology, and can be understood to have a substantial investment in this paradigm. The question is why this is so. From the viewpoint of the enterprises (demand side) intending to introduce OSS, the most frequently cited reason for investment is described as cost-reduction. However, the pure cost-reduction on the part of these enterprises (or governmental organizations) may lead to the shrinking of the market of IT companies (supply side). In such an environment it is necessary for supply side IT companies to cultivate new markets to maintain or expand their business. Somewhat ironically, the IT companies are facing the cost pressure from OSS in some cases, and then these companies will need to incorporate outside resources (such as outside OSS developers and their contribution) into their inside product portfolios to maximise their R&D returns.

In short, supply side companies have to reduce the cost as required by competitive pressure, a pressure partly brought amplified by OSS, and participate in the development processes to ensure their continued competitiveness in the market. This paper analyzes how OSS affects Japanese IT companies' business growth both through simple use and by deeper engagement as a stakeholder in the community.

## **2 Open Innovation and OSS Business Model**

### **2.1 Open Innovation, and Matter of Free Ride**

Chesbrough (2003) describes traditional separate style business strategy as "Closed Innovation", in which enterprises develop ideas, marketing, support, and financing by themselves. And, research and development is almost exclusively performed intra-enterprises. However, the superiority of "Closed Innovation" as an economic model for creativity is being reduced because of the liquidity of labour, improvements in the knowledge power of employees, and the existence of venture capitals to drive new innovation elsewhere. In this context business enterprises have begun to use inflow and outflow of knowledge to fit their purposes, not only accelerate their internal innovation, but encourage the innovation to be used externally. This process is "Open Innovation" which blurs boundaries between business enterprises, and by joining internal resources and external resources together, extra economic values for all parties concerned is generated.

This development style is essentially the same as the longer established OSS development style. OSS is developed by a "Community" of stakeholders, which may be structured as a Bazaar style or a Cathedral style, it tends to be open for all developers, software engineers and business enterprises with an interest in participation, and they can participate or withdraw any stage in the overarching process (though naturally continued participation is incentivised in terms of increase ownership of the technology produced or increased customisation to fit individual use-cases). From the perspective of businesses engaging as stakeholders in this field, they join a community beyond the separated confines of their own organisation in order to absorb the fruit of innovation and developed software from third parties, who participate for similar reasons in turn. It is essentially a situation of enlightened self-interest.

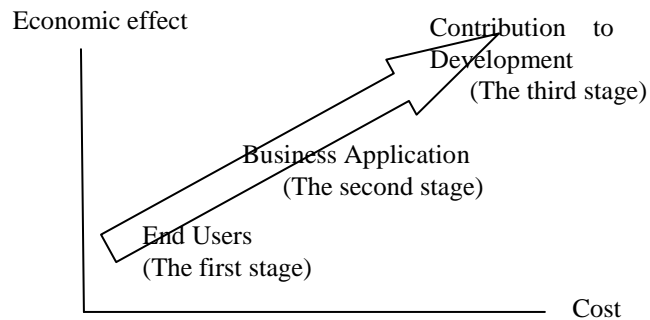
One immediate consideration from this perspective is that the development of OSS technology inherently reduces costs for each stakeholder, with the complete

burden of development being shared by all contributors. Conceptualising OSS technologies as platforms on which products or services can be delivered, it is easy to extrapolate that OSS contributions therefore can be directly tied into reductions in the cost of bringing new products and services to market, and therefore provides a market benefit through what can be called a leverage effect.

From a less positive perspective, if we assume rational individuals or business enterprises with to obtain convenience maximization, the obvious next step would be to free ride on OSS development, and seek to obtain the platform benefits without the burden of contribution. However, it is equally true that if every individual (or every business enterprise) behaves rationally, value provided by OSS will immediately drop, and quickly run dry. Ghosh (1998) explains this by introducing a “Cooking-pot Market” model, whereby assumptions of inexhaustible supply via digital copying are off-set by understanding that the cost of development, the human labour involved, is both exhaustible and actually based on technical elites. Therefore, rational business enterprises that want to absorb the outcome of OSS must take part in the OSS development processes and contribute to the future of the platforms.

## 2.2 Three-step Business Model of OSS

Kunai (2010) categorizes the underlying OSS business model a “Three-step Model” regarding the engagement by business enterprises. As they move up the ladder, though the cost of the development increases, business enterprises can increase the economic effects as shown in Fig. 1.



**Fig. 1.** Three-step Business Model of OSS

In the first stage, business enterprises use OSS as End Users, and they only use OSS in the same way as proprietary software. Their primary purpose is cost reduction, but economic effect is very low. In the second stage they use OSS in a more engaged manner, expanding functional features they need, constructing application software,

serving support for their customers, and integrating systems. In this stage, the economic effect is comparatively higher than that of the first stage, though cost rises because of the demand of manpower and equipment to launch and sustain these derivative businesses.

In the third stage they participate in the “mainstream” development process of OSS, and bring forth the highest economic effect. They contribute to the “Community” by providing physical support and financial backing. The development style of this stage is different from to stage two, primarily because they develop software in association with other companies, including their competitors. This is - as referenced before - enlightened self-interest. The “Community” has many resourceful software engineers, who contribute to the development process of OSS by fixing bugs or supplying patches. Those closest to each business sector can address its requirements most effectively, and - on a platform rather than product level - competitors can work together to enable the next generation of their difference products without undertaking 100% of the engineering on their own. In this way business enterprises become to be able to reduce the cost of the demand of manpower and equipment. Moreover, developing with OSS engineers and other companies, they are able to acquire the “Leverage Effect”. Thus the underlying hypothesis is that process of “Open Innovation” enables business enterprises to absorb the fruits of the “Community” of OSS. Now, this paper tries to establish this hypothesis by the questionnaire survey of IT companies in Japan.

### 3 Study Methodology

The methodology we employ in this study is to investigate the effect on the business growth by OSS utilization and contribution in Japanese IT companies (with our primary focus being the supply side of information solutions in business processes). As is described by Kunai, we assume, “The more IT companies contribute to OSS communities, the more they are able to acquire economic effect”.

According to this methodology, we sent out a detailed questionnaire survey to IT companies in Japan, during 2012. The survey slips were sent to 642 companies which accede to Information Industry Association in Japan, and 191 companies gave us replies (collection rate: 29.8%). The survey was conducted in the form of a questionnaire containing the items shown in **box 1**. In the survey we questioned the utilization and contribution of low-level OSS (such as Linux, Database technologies, Programming Languages, etc.). Application-level software (such as ERP, CMS, CRM, etc.) is excluded, because case examples of development of such software are rare in Japanese IT companies. All questions are selected from among alternatives, discrete data.

**Box 1: OSS Utilization and Contribution Questionnaire Survey Slips  
towards Japanese IT Companies**

Company profile:

- Q1. Home City
- Q2. Inauguration of Business
- Q3. Main Business Service
- Q4. Capital Stock
- Q5. Number of Employee
- Q6. Number of Developers (programmers, software engineers, etc.)
- Q7. Sales Amount
- Q8. Growth Rate of Sales (present period)
- Q9. Prospect of Sales Growth Rate (subsequent period)
- Q10. Growth of Employee Number (present period)
- Q11. Prospect of Employee Number's Growth Rate (subsequent period)

Utilization of OSS: (rate of utilization)

- Q12. Utilization of Linux
- Q13. Utilization of Apache HTTP Server
- Q14. Utilization of Database technologies (MySQL, PostgreSQL, etc.)
- Q15. Utilization of Programming Language Ruby
- Q16. Utilization of Other Programming Languages (Perl, Python, PHP, etc.)
- Q17. Utilization of Ruby on Rails

Contribution to OSS Communities: (amount of direct investments  
and manpower costs of OSS engineers inside company)

- Q18. Contribution to Linux
- Q19. Contribution to Apache HTTP Server
- Q20. Contribution to Database technologies (MySQL, PostgreSQL, etc.)
- Q21. Contribution to Programming Language Ruby
- Q22. Contribution to Other Programming Languages (Perl, Python, PHP, etc.)
- Q23. Contribution to Ruby on Rails

## 4 Result and Discussions

### 4.1 Utilization and Contribution of OSS

In the questionnaire survey, we ask the utilization ratio of OSS - how much percentage of software development is utilized by OSS in total. "100%" in Linux

means that the company uses Linux for all the server operating system, and then “50-74%” in Ruby indicates that Ruby is used in the range of 50-74% software development in the company for example. In this company, they probably utilize “other languages” for the rest of 25-50%. The results are shown in Fig.2.

Most Japanese IT companies use OSS in their business field, especially the Linux operating system core components and various Database technologies (MySQL, PostgreSQL, etc.). At the same time, the use rate of Japanese-origin technology like Ruby and its American-based development framework Ruby on Rails are unexpectedly low (Fig. 2). It is because that in the questionnaire survey the poll of IT companies contains wide ranges, including system integrators, software developers, and network service companies. Ruby use is currently limited within the field of web applications development, along with Ruby on Rails.

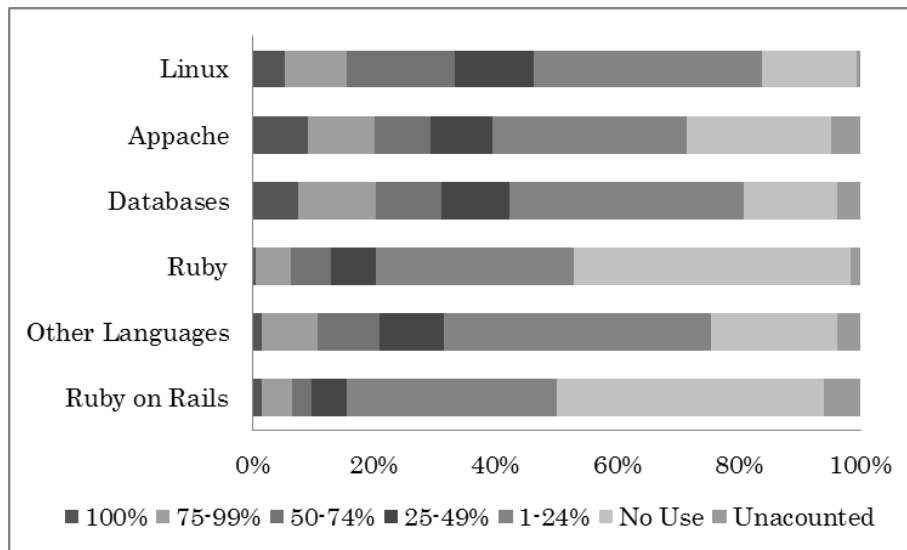
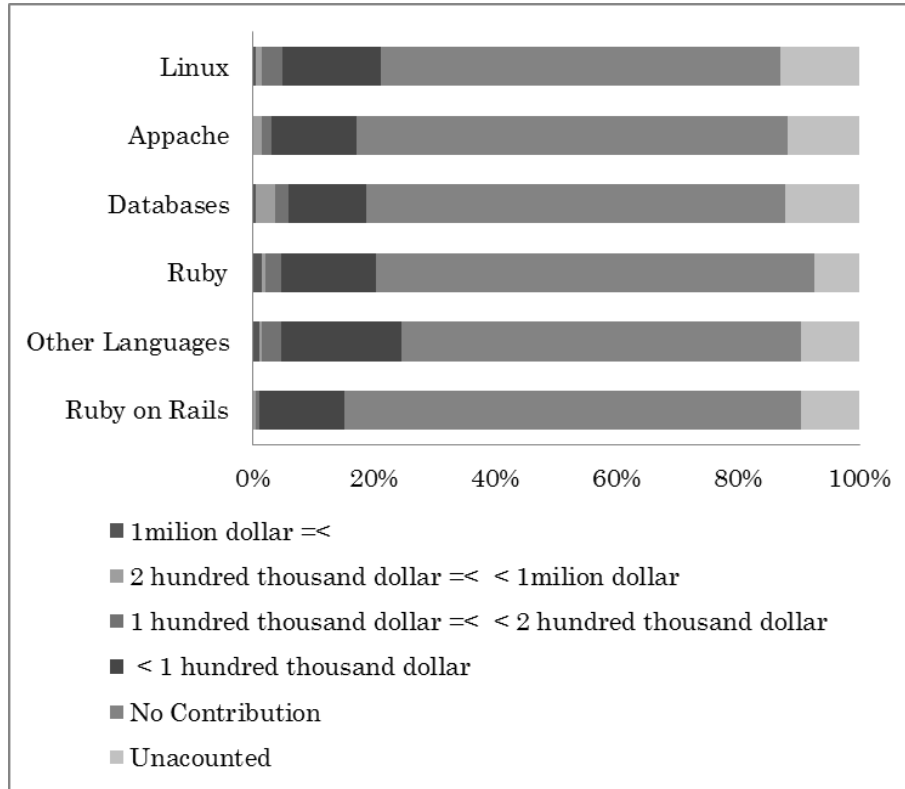


Fig.2. Utilization of OSS in Japanese IT Companies n=191

The survey also revealed that the percentage of companies which contribute to OSS communities is relatively low in Japan (Fig. 3). The terms of currency in the questions were originally in Japanese Yen, however, the terms are converted into US Dollars (100JPY = 1USD) in order that the readers can capture the volume easily. The result of our study indicates that most of Japanese IT companies use OSS without contributing to OSS development process might show that they are positioned as “free riders” in non-application level. However, the survey also confirmed that, on average, about 20% of IT companies contribute to OSS development process.

The question is therefore what the correlations between the utilization of OSS and the contribution towards OSS are.



**Fig.3.** Contribution to OSS communities in Japanese IT Companies n=191

## 4.2 Correlation between Utilization and Contribution of OSS

### Correlation of utilization among OSS

As a whole, the survey shows that correlations of utilization among OSS are strong, and inside this context the, correlation of Linux with regards other OSS (especially Apache and Databases) are quite strong. Most IT companies supply business solutions by using OSS components based on Linux OS and its ecosystem in Japan.

Correlations between Ruby and Ruby on Rails are also strong, though correlations between Ruby and Databases are weak by comparison with other scripting languages.



**Table 1.** Correlations of utilization among OSS

	Linux	Apache	Databases	Ruby	O.L.	RoR
Linux	-	.692**	.625**	.469**	.507**	.402**
Apache		-	.554**	.554**	.494**	.409**
Databases			-	.473**	.581**	.459**
Ruby				-	.232**	.812**
Other Languages					-	.255**
Ruby on Rails						-

Spearman's rank correlation coefficient \*\* 1% level of significance

### Correlation of contribution among OSS

Correlations of contribution among stakeholders in OSS are also strong. In the same context, correlations of cross-contribution between Linux and other OSS (especially Apache and various Database technologies) are comparatively strong. It also held true that correlations of Apache between other OSS (various Database technologies and various Scripting Languages) are also strong.

**Table 2.** Correlations of contribution among OSS

	Linux	Apache	Databases	Ruby	O.L.	RoR
Linux	-	.836**	.773**	.616**	.696**	.447**
Apache		-	.765**	.580**	.702**	.430**
Databases			-	.550**	.802**	.526**
Ruby				-	.575**	.772**
Other Languages					-	.622**
Ruby on Rails						-

Spearman's rank correlation coefficient \*\* 1% level of significance

### Correlation between utilization and contribution of each OSS

As a whole, correlations between utilization and contribution of companies in many OSS technology types are not significant. The exception was that the correlation between Ruby and Ruby on Rails in this context is significant in 1% level. And those of Other Languages between Apache and Databases technologies are rather weak but significant in 5% level.

We are led to the conclusion that in Japan, most of IT companies make use of Linux, Apache, and database technologies. These types of technology as essentially used in the same manner as proprietary software. Of course, these OSS technologies are being developed thorough worldwide communities by the contribution of many engineers and businesses, so many Japanese IT companies gain their value without much pain as “free riders.”

In contrast, Ruby has been developed mainly by the Japanese community (approximately half of its developers are Japanese). Justifiably, companies conducting business using Ruby get engaged in the Ruby community around Japan, and by extension they also get engaged in the development process of Ruby on Rails in America. To some extent this is pure self-interest in terms of building the shared platform, and to some extent it shows that Ruby and Ruby on Rails are still very much developing OSS technologies and have not yet gained a stable valuation in business use yet. It is hard to be a free rider at this point in their lifecycle, so adopters are inherently positioning themselves as investors and contributors.

In addition, it is interesting that the correlation between utilization and contribution of other languages (Perl, Python, PHP, etc.) is also shown. Of course, the number of Japanese developers in these languages' communities is small, different from Ruby. This shows that these OSS script languages, including Ruby, have not gained stable valuation in business use yet, either.

**Table 3.** Correlations between utilization and contribution of OSS

contribution \ utilization	Linux	Apache	Databases	Ruby	O.L.	RoR
Linux	.136	-.002	.004	.128	.083	.110
Apache	.151	.135	.054	.149	.125	.111
Databases	.050	-.016	.052	.132	.098	.105
Ruby	.031	-.013	.007	.324**	.114	.351**
Other Languages	.144	.161*	.189*	.099	.272**	.140
Ruby on Rails	.087	.086	.065	.331**	.159	.420**

Spearman's rank correlation coefficient

\*\* 1% level of significance, \* 5% level of significance

### 4.3 Effect on Business Growth by Utilization and Contribution of OSS

The larger question is how we can survey the effect on business growth by utilization and contribution of OSS, thereby explaining more clearly the actions of the companies in this market as rational actors. We understand that business growth is affected by many factors such as market conditions; however, in order to test our exploratory hypothesis, we investigated the correlations between indicators of business growth and utilization of OSS, and contribution to OSS communities. As a whole the data indicated that a subsequent period prospect of sales growth rate might be impacted by utilization of OSS, and in this context, Ruby favorably compared with other OSS in Japan. At the same time, there is little correlation between indicators of business growth and contribution towards OSS.

The results show that, in Japanese IT companies, the utilization of OSS has an insignificant effect on the present sales growth, but when they use OSS they tend to make allowance for the subsequent sales growth. However, the contribution to OSS communities has an insignificant effect both on the present sales growth and on the

subsequent sales growth. As rational economic actors, their investment decisions are impacted by this understanding.

**Table 4.** Correlations between business growth and utilization of OSS

	Growth Rate of Sales (present period)	Prospect of Sales Growth Rate (subsequent period)	Growth of Employee Number (present period)	Prospect of Employee Number's Growth Rate (subsequent period)
Linux	.191**	.245**	.207**	.133
Apache	.167*	.220**	.079	.066
Databases	.131	.222**	.026	.067
Ruby	.135	.214**	.063	.113
Other Languages	.098	.176*	.052	.092
Ruby on Rails	.055	.178*	.061	.068

Spearman's rank correlation coefficient

\*\* 1% level of significance, \* 5% level of significance

**Table 5.** Correlations between business growth and contribution of OSS

	Growth Rate of Sales (present period)	Prospect of Sales Growth Rate (subsequent period)	Growth of Employee Number (present period)	Prospect of Employee Number's Growth Rate (subsequent period)
Linux	-.091	.007	-.032	-.089
Apache	-.031	.021	-.092	-.127
Databases	-.036	.092	-.083	.020
Ruby	.052	.047	.072	.058
Other Languages	.019	.057	-.029	.002
Ruby on Rails	.034	.075	.018	.049

Spearman's rank correlation coefficient

\*\* 1% level of significance, \* 5% level of significance

## Conclusion and Challenges for the Future

It has become commonplace for business enterprises to use OSS in their business. The logic we understand as framing this such engagement is that the competitive edge that comes from technical advantages delivered by using OSS, and - using the same logic - it is therefore indispensable for them to contribute or participate in the development process of OSS as Kunai proposes. However, our data shows that major OSS, like Linux, Apache, MySQL, and PostgreSQL, are still utilization objects for Japanese IT companies, or "Frontier" technologies. They have been able to get a competitive edge only by the utilization of OSS, and contribution to OSS projects or communities has not been linked to the business growth for them.

At the same time, exceptionally, Ruby and Ruby on Rails are both utilization and contribution objects for Japanese IT companies. They have to contribute or participate in the development process of both technologies. This appears to be because Ruby and Ruby on Rails are still platforms very much under development and have yet to gain a stable valuation in business use. The contribution to Ruby and Ruby on Rails is not linked to the business growth as other OSS, or motivated by the same adoption criteria.

And, we excluded the survey of application-level software (such as ERP, CMS, CRM, etc.). For the future, case examples of development of such software are expected to increase in Japanese IT companies. Moreover, to survey the effect on business growth we take on growth rate of sales and growth of employee number as indicators of business growth. There are also other indicators to estimate business growth. These are our research challenges for the future.

Our data is not perfect, and the survey included collected data from many types of supply side IT companies is lumping together. The advantage is that this poll of IT companies contains a wide range, and their utilization and contribution of OSS are different from each other but provides a snapshot of the overall market. To analyze the effect on business growth by utilization and contribution of OSS in more detail, and to properly understand the free rider versus investor issue that we have uncovered, will require more assorted statistical analyses. One proposed step for further research is to expand future survey criteria to the demand side of IT businesses, who we might term as consequential OSS users, and who also may contribute to the development process of OSS due to its open nature. Even broader research into non-IT but significant software development areas such as banking or heavy industry could also prove fruitful.

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