

# Review on Software Ecosystem: An Emerging Area

**Rohit Deshmukh**

Department of Information  
 Technology MIT AOE, University  
 Of Pune [MH], India  
 rohitdesh92@gmail.com

## ABSTRACT

A software product line (SPL) companies expanding their platform outside their organization, which is now termed as a software ecosystem approach. This approach investigates the relationship between companies in software industry. Companies work together with co-ordination to achieve their strategic goals. In this paper we undertake a review on the software ecosystem as an emerging area. This paper also described challenges, implications and new approach of software ecosystem as business perspective rather than only technical. We have focused on three dimensional perspectives of software ecosystem as technical, social and business including most recent investigated areas of software ecosystem. This paper emphasis on the, research areas needed to develop sustainable software ecosystem.

## General Terms

Software Engineering, Shared Market.

## Keywords

Software Ecosystem, Software Development, Social Networking, Software Product Lines.

## 1. INTRODUCTION

In corporate world concerned to software industries software product lines (SPL) have limited scope in intra- organization. All the goals of the company cannot be incorporated in a software product line. For successful accountable growth of an organization it should expand its platform outside of an organization.

Software product line development basically refers to the methods of software engineering, tools and techniques for development of similar software system from a shared set of software assets using a common means of production.

Software product lines have also gone through various transitions from product centric to a new approach for means of mass production. Product centric approach of software product lines effectively applied to the software development lifecycle of individual product from its inception of design, implementation, testing, deployment and maintenance.[16]

But, this approach has some shortcomings that it could not sustain for mass production and managing commonalities and variabilities or efficient development of product line portfolio.

So that, organizations changed their perspective to an efficient means of production and they saw a system as a perspective of mass production.

That is, a single production system which is capable of producing all the products in product line rather than creating multitude of inter-related products.

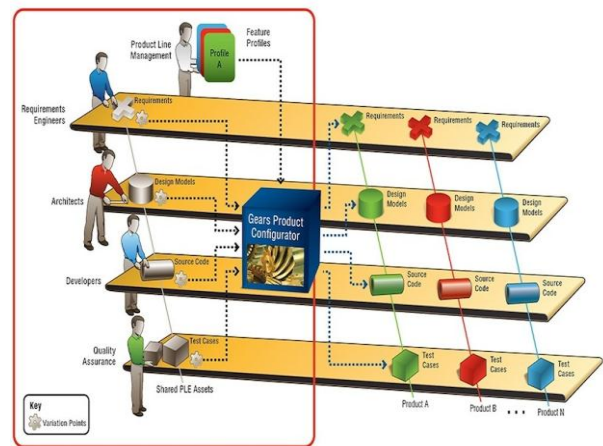


Figure 1: Software Product Line Engineering.[16]

Because of this software product lines are viewed as most successful approach in software production at intra-organization level. And because of its limitations regarding to boundary, software organizations should expand their platform outside of organization then company transitions from product lines to software ecosystems.[4][16]

Also there are two reasons for companies to shift towards software ecosystem those are amount of functionalities need to be developed should satisfy needs of the customer which is more important than completing product in prescribed time & the R&D investments which offers acceptable amount of returns on the investments .

Secondly, mass customization drives needs for significant R&D investments for successful software applications like Web or mobile applications. Extending the products which includes platform with externally developed components or applications

provide effective mechanism for mass customization. That scope is not limited to the organization then such comprehensive scope will be termed as ecosystem [1][2].

Software Ecosystem is abbreviated as SECO's [4].

SECO is defined as "a set of businesses functioning as a unit and interacting with a shared market for software and services, together with relationships among them, frequently underpinned by a common technological platform or market and operating through the exchange of information, resources, artifacts" [4].

Software Ecosystem is a set of businesses functioning as a unit and interacting with a shared market for software and services, together with relationships among them.

Study of software ecosystem is emerging discipline that investigates the relationship between the companies in software industry.

Every company has its own strategies and implications but to achieve it in prescribed time & in proper way software ecosystem provides a comprehensive perspective which includes both technical and business perspective.

In this paper we are discussing software ecosystem as an emerging area, key concepts, implications, strategies and how future goals can be achieved.

## 1.1 Benefits of SECO

- Offering maximum product functionalities to customers.
- Attracting attention of new users as business approach.
- Motivate & speeds up innovation through open innovation in software ecosystem.
- Collaborate the partners in an ecosystem for sharing cost of innovation.
- Increased stickiness to application platform [1].

## 1.2 Challenges in turning to software ecosystem

There are various challenges while shifting from a traditional or existing software product line system to the software ecosystem. This can be viewed as shift from product centric to the product line centric company including vision to achieve desired business outcome.

One of the major challenge is modeling application development in terms of user will understand application with minimal instruction.

While there also many domains are simply too complicated to create a domain specific language and associated configuration and design environment that covers the needs of a sufficiently large number of users [1].

## 1.3 Taxonomy of Implications

An implication of software ecosystem affects the every functionality of an organization. The approach of design & implementation of product is more affected than any other functionalities in the company. There are three main areas where we mainly should focus on those are co-ordination mechanisms, engineering agility and product composition be achieved.

### 1.3.1 Coordination Mechanism

In transition into the software ecosystem main change in internal system and software ecosystem approach is that for external

development teams proper coordination mechanism in form of standardized process models, tools and approach of working should made available. So, various traditional CMMi approaches fail to incorporate needs of software ecosystem.[1]

There are various parties involved in software ecosystem so traditional centralized approach seems difficult to meet these challenges and it will also lead to great complexity and commotion. However, there is one solution for this problem and that is 'Decentralized approach'.

Traditional software development activities like requirement management, architecture design, integration, quality assurance management and SCM strictly revolves around the centralized approach. These all processes needed to be decentralized and during all stages all assets involved in larger system need to synchronize and coordinate.

Coordination on the system can be achieved through software architecture rather than other development phases.

That is accomplished by dividing overall system into the design decisions, interfaces defined for components and functional requirements would be developed independently by the various development teams. We will require another change in the management i.e. centralized requirement management & roadmapping are replaced by bottom up team driven roadmaps and requirement specifications.

Advantage here is rather than focusing on the centralized overall functionalities these functions allows backward compatibility which allows great visioning and the compositionality. This will mitigate the efforts needs to be spent centrally.

### 1.3.2 Engineering agility

As stated previously software ecosystems speeds up innovation is true as concern with the agility in development of frequent platform releases. However it is seen that software product lines have limited scope because of dependencies between different components so practically takes much amount of time in development as well as testing and quality assurance.

Engineering agility says challenges regarding to frequent releases of products should be managed carefully.

### 1.3.3 Product composition

Product composition is an important issue in software ecosystem because; there are also changes in the product composition ownership.

Further, products with the functionality are provided by the external organization or developer. So that company is no more product line but instead a customer. [1] All requirements given by the customer and he himself provides a solution which will suit for his needs. Developers have task to incorporate that solution in the real time. In this way product composition ownership takes shape in software ecosystem.

Also, proper aesthetic user interface is needed to work comfortably for any user. User compels developers by providing their own solution regarding to user interfaces they want. This may contain elements from various parties so that platform company should also provide their basic user interface in order to make user interface more proper and attractive.

Platform company must have to work and give special emphasis to address this issue and make it better by minimizing these hurdles.

## 1. RELATED WORK

Klaus Schulties, Cristophn Elsner and Daniel Lohmann mentioned a set of research questions to guide systematic mapping study (SMS) to present a review of primary study of SECO's [4].

- 1) What are the main characteristics of SECO's ?

- 2) What is currently known about the benefits, challenges, limitations of SECO's?
- 3) What are the implications of SECO studies for research and practice in Software engineering?
- 4) What are the main areas studied from the perspective of SECO's?

Software ecosystem is an emerging field many researchers are investigating how it can be implemented properly. Jan Bosch in [2] lucidly explained current trends and importance of software ecosystem.

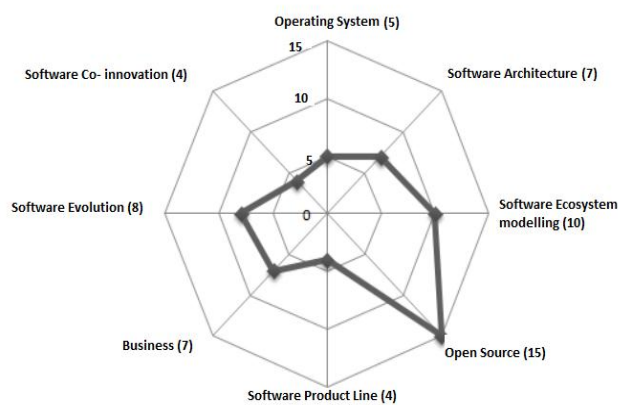
Also Klaus Schulties, Cristoph Elsner and Daniel Loochmann in [2] introduced new approach of software ecosystem i.e. ISECO industrial ecosystem. Software ecosystem provides a new approach to the view business rather than only technical it provides technical as well as lucrative approach and provides sustainable environment for software industry that is nothing but industrial ecosystem (ISECO).

Industrial software ecosystem will help organizations to coordinate their activities and to have proper relationship among the organizations situated at different places. This will mainly focus on customer centric functionalities.

Industrial software ecosystem simply means platform available outside the boundaries of the organization which will allow rapid product development using third party developers as well as shared components.

Amazon, Nokia and Apple are pioneers in SECO and also treated SECO as relevant SE research.

There are eight most frequent areas found in software ecosystem [4].



**Figure 2: The most frequent areas investigated in Software Ecosystem [4]**

Areas of software ecosystem

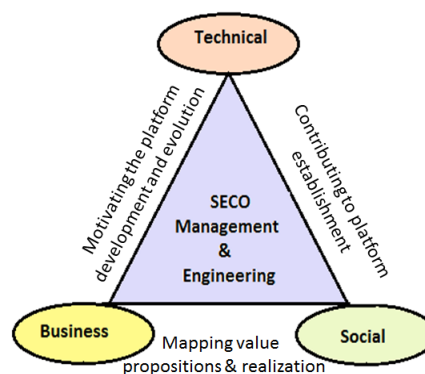
- 1) Software evolution
- 2) Software co-innovation
- 3) Business
- 4) Software architecture.
- 5) Software ecosystem modeling.
- 6) Open source
- 7) Software product line
- 8) Operating system.

Jan Bosch in [1] stated benefits and implications of turning from software product lines to software ecosystem and as stated above there are mainly eight areas found in the software ecosystem[4] where more research is needed.

Jansen et al.[17] frames SECOs in three level view which will help to address challenges regarding to SECO. First level is Software vendor level where objects of study are the actors and their relationship in context of SECO organization. The second one is Software supply network level; in this level objects of study are the software supply network (SSNs) and it also includes relationship among various stakeholders considering health and stability of software ecosystem. Finally, third level is a SECO level which includes SECO itself and relationship with its attributes. This model helps to explore SECO and also there is a further scope for more exploration in order to fit model for mass product development and to achieve high profitability by maintaining health of ecosystem.

Software Ecosystem is an emerging research area and its research opportunities are classified into the three basic dimensions according to SECO 3+1 view [4]. This model supports SECO roadmap in software engineering.

There are four dimensions in this model those are Technical dimension, Business dimension, Social dimension and M&E dimension



**Figure 3: "3+1"view of SECO M&E [4]**

### Technical Dimension

Technical dimension focuses on the platform like market, technology, infrastructure or organization through platform domain engineering process establishing its lifecycle, commonalities and variabilities management defining platform features [4].

Goal of this dimension is to select target platform in order to begin product development in proper way. Also this dimension let us understand platform health in form of productivity, robustness, architectural styles, elements of factors of uncertainty, complexity, balanced componentization and visualization during its evolution.

### Business Dimension

This dimension focuses on SECO knowledge flow such as artifacts, resources and information through business establishing SECO goals and action plans by programs and project. Also focuses on the software ecosystem innovation which links to software market and strategic planning and let us understand how, when, where and who will perform this goal.

GQM (Goal – Question – Matrix) approach is used for this kind of dimension. In this selecting SECO goals then prepare the questions in order to better understand the goals and defining, collecting and

analyzing related matrix. This dimension directly appears in three SECO areas like SECO modeling, Business, software co-innovation [4].

### Social Dimension

Social dimension focuses on the stakeholders through balancing propositions and realization of utilities, promotion and knowledge. Goal of this dimension is to understand how social networks creations, organizations and maintenance can affect the communities that belong to SECO.

### SECO Management & Engineering Dimension

This dimension merges all three basic dimensions through three relationships towards an establishment of a technological infrastructure.

## 3. ANALYSIS

A Software ecosystem is emerged as a new area so there is much scope for research and scope for enhancement for defining software engineering terms more clearly with software ecosystem perspective.

It is important to map strong and weak aspects of SECO platform to enhance framework automatizing in order to monitoring SECO of platform in both local and global perspective.

While changing the perspective of product development from Software Product Lines (SPL's) to Software Ecosystem, it is important to analyze platform issues like platform interface stability, security, reliability, and business strategy in order to integrate and to get well defined solutions in order to validate SECO activities in SPL engineering. Also while making platform available outside the boundaries of an organization it is important to research suitable architectures, styles and assessment of open and flexible architecture in order to support common contributions to different platform.[12][13]

Also it is important to have a strong framework for actors including stakeholders and their relationship for organization of software ecosystem.

## 4. CONCLUSION

This paper gives a Review on the software Ecosystem (SECO) as an emerging area and bright research topic. This paper gives information mapped what is currently known to us and analyzed them through three dimensional perspective including its implications, goals, challenges, most recent areas to be focus on and 3+1 model which comprehensively enlightens Software Ecosystem. SECO is field of software engineering body of knowledge and also there is future scope for enhancement of coordination and relationship in all eight areas of software ecosystem.

## 5. REFERENCES

- [1] Jan Bosch "From software product lines to the software ecosystem" proceeding of 13<sup>th</sup> International software product line conference 2009.
- [2] Jan Bosch "Software Ecosystem Implications for Strategy, Business model and Architecture" 15<sup>th</sup> International Product line conference 2011.
- [3] Klaus Schulties, Cristoph Elsner, Daniel Lohmann "Moving Towards Industrial Software Ecosystem : Are our software Architecture fit for future ?" 2013

- [4] Rodrigo santos, Claudia Werner, Olavo Barbosa, Carina Alves " Software Ecosystem: Trends and Impacts on software Ecosystem" 2012 Brazilian symposium on software engineering.
- [5] J. Bosch, "Software Product Families in Nokia",Software Product Lines Conference (SPLC 2005), Springer-Verlag, 2005.
- [6] J. Bosch, The Challenges of Broadening the Scope of Software Product Families, Communications of the ACM, Volume 49, Issue 12, pp. 41 - 44, December 2006.
- [7] P.R.JCampel and F.Ahmed,"A three Dimensional view of software ecosystem " in proc. Of Fourth European conference on Software Ecosystem.: Companion Volume, ser.ECSA'10.New York, NY, USA.
- [8] J. Bosch and P. Bosch, "From integration to composition: On the impact of software Product lines, global development and ecosystems,"J.syst.softw.,vol.83, no.1, pp.67-76, Jan 2010.
- [9] Software Product Line Hall of fame, [http://www.sei.cmu.edu/productlines/plp\\_hof.html](http://www.sei.cmu.edu/productlines/plp_hof.html).
- [10] <http://en.wikipedia.org/wiki/Ecosystems>
- [11] J.Bosch, The challenges of broadening the scope of Software product families, communications of the ACM, volume 49, Issue 12, pp. 41 – 44, December 2006.
- [12] Santos, R., and Werner, C.," Treating Social Dimension in software ecosystem through Reuse ECOS Approach ". In: Proc. Of 6<sup>th</sup> IEEE DEST, Campioned' Italia, Italy, 2012.
- [13] Santos, R., and Werner, C., "Treating Business Dimension in software ecosystem". In 3<sup>rd</sup> ACM MEDES, San Fransisco, USA, 197-201,2011.
- [14] Barbosa, O.,and Alves, C.,"A systematic mapping study on Software Ecosystems ".In: proc. Of the 3<sup>rd</sup> IWSECO, 2<sup>nd</sup> ICSOB, Brussels, Belgium,15-26,2011.
- [15] B. Iyer, C.Lee, and N. Venkatraman, "Managing in small world ecosystems: some lessons from Software Sector," California Management Review, Vol 48, no.3, pp. 28-47, 2006
- [16] [http://www.biglever.com/overview/software\\_product\\_lines](http://www.biglever.com/overview/software_product_lines).
- [17] Santos, R., and Werner, C and Siva.M. , "Brecho- VCM: A Value based approach for Component Markets" International Transactions on Systems science and applications, 2010.

