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## External knowledge absorption in Chinese SMEs

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## **Appendices**

The list of Appendices consists of five parts.

**Appendix 1:** Interview Instruction

**Appendix 2:** Interviewee Description

**Appendix 3:** Survey Questionnaire

**Appendix 4:** Scatter Plots between the EKA Mechanisms and SME Performance

**Appendix 5:** Effects of Different ECU Purposes

**Appendix 1: Interview Instruction**

(中英对照 Chinese-English)

**介绍访谈目的 Introduction to Purposes of the Interview**

了解中小企业如何识别、吸收和运用来自企业外部的有用知识或者技术，以及新知识吸收利用的管理过程

To examine how SMEs recognize, assimilate, and exploit useful external knowledge and what challenges they may face and how they overcome the them.

**访谈对象信息 Basic Information of Interviewees**

1. 贵公司的名称 Name of the firm
2. 主要业务 Major business
3. 受访者的职务 Position inside the firm of the interviewee
4. 公司成立日期 Founded date of the firm
5. 企业规模：员工数量 Firm size in term of number of employees

**访谈问题 Interview Questions**

1. 很多公司在从事开发的过程中会遇到缺少某些技术能力或者知识的时候，因此可能需要向外界寻求解决方案，贵公司遇到这样的情况多么？请选择最能够描述贵公司状况的答案：

1.几乎没有； 2. 偶尔； 3.有一些； 4.很频繁； 5.几乎所有项目都会涉及

Many firms refer to external sources for useful knowledge in addition to internal knowledge creation activities (e.g., internal R&D) when they lack specific technology or knowledge in running their business. How often does your firm refer to external sources for useful knowledge? Please choose one of the following answers which describe the situation in your company most approximately:

1.None; 2.Very few occasions; 3.Sometimes; 4.Very frequently; 5.Almost all the projects or businesses are involved.

2. 这些外部技术/知识的可能来源都有哪些，贵公司是如何跟这些公司/人员建立联系的？

What are the potential sources your company refers to for useful knowledge? What are the connections between your company and the potential sources?

3. 向外界学习获取知识的手段都有哪些？贵公司有没有特定的流程或者模式来向外界学习新知识？

How does your company approach those sources for useful knowledge? Or, are there any explicit instructions or processes in your company to direct you on how to communicate with external sources for useful knowledge?

4. 你们联系外部机构的时候，对方的大小、声誉会是考虑的因素的么？您觉得

这些因素会影响最后的结果么？

Before your company contact external sources for useful knowledge, do you consider their sizes and reputation? Do such factors influence the outcomes?

5. 面对需要联系外界解决技术问题的情况，一般由谁决定是自己研发还是向外界寻求帮助.谁来联系潜在公司，谁来负责实际的操作过程？  
Who, inside your company, usually decides whether it is necessary to refer to external sources for useful knowledge instead of relying on internal human resources or R&D activities?
6. 在做出是否尝试吸收某种知识的时候，您主要考虑哪些方面？ What aspects do you consider when making decisions about whether to absorb specific external technology or knowledge?
7. 知识消化吸收和利用的过程一般是怎样的？新技术或者新知识怎么被存储的？  
How does your firm assimilate and use external knowledge after communicating with external sources? How is new knowledge being stored?
8. 您是如何（促使）外部的公司跟公司合作的意愿的，有什么激励合作方的方式？请举例说明。  
How do you enable external sources to collaborate? What are the incentives for them? Please provide some examples to demonstrate your points.
9. 这选择与外界合作而不是完全自己开发的好处哪些？请举例说明。这选择与外界合作而不是完全自己开发有没有明显的负面影响？  
According to your experiences, what are the advantages of referring to external sources for useful knowledge instead of relying on internal human resources or R&D activities? What are the disadvantages?
10. 有没有出现贵公司知道了需要什么已经存在的技术或者知识却找不到合适的外部知识来源的状况？您有具体的例子么？ Are there cases that your firm recognizes specific existing knowledge but cannot find potential sources which you can refer to? Can you provide any relevant examples?
11. 有没有公司找到了合适的外部资源但是仍然没有成功的吸收应用外部知识的情况？您觉得什么原因导致它不成功?您有具体的例子么？ Are there cases that your firm found and approached potential external sources but still failed to absorb their technology? What are the possible reasons? Can you provide any relevant examples?
12. 除了以上的问题外，您对中小企业的知识吸收能力的问题，还有别的评论么？  
Except above questions, do you have other comments on the absorptive capacity of SMEs?

**Appendix 2: Interviewee Description**

Number	Position of Interviewee	Gender	Firm Age <sup>9</sup>	Employee Number	Industry/Core Business	Firm Location
1	Co-founder and CTO	Male	3	10-15	Information technology; E-commerce	Shenzhen
2	Founder and CEO	Male	2	6-10	Entertainment and internet technology (Film distribution)	Beijing
3	Co-founder, deputy general manager, and R&D director	Male	4	50+	Biotechnology (Genome sequencing technology)	Shenzhen
4	Founder and CEO	Male	3	25	Original equipment manufacturing	Shanghai
5	Co-founder and COO	Male	1	≈30	Hardware & equipment (Power supplier/supply system)	Shenzhen
6	Co-founder and CTO	Male	2	10-15	Hardware & equipment (Intelligent wearing devices)	Shenzhen
7	Founder and CEO	Male	2	≈15	Online finance service (Private lending business)	Beijing
8	Founder and CEO	Male	3	3	Hardware & equipment (Civil drone production)	Shenzhen
9	Founder and CEO	Female	3	30+	Online education and its technology	Beijing
10	Co-founder and CTO	Male				
11	Founder and CEO	Male	5	≈50	Software & internet; Information technology; E-commerce	Beijing
12	Co-founder and COO	Male	3	6-10	International trading and product development	Shanghai
13	Founder and CEO	Male	8	≈35	Software & information technology Service	Beijing
14	Co-founder and CEO	Male	7	100+	Equipment and technology service	Shenzhen
15	Co-founder and CEO	Male	4	10-20	Hardware & equipment (Intelligent wearing devices)	Beijing
16	Co-founder, COO, and IP manager	Female	3	55	Original equipment manufacturing (Robotic hand)	Shenzhen

<sup>9</sup> Ages of the firms are calculated to the date of the interview occurrence.

**Appendix 3: Survey Questionnaire**

(中英对照 Chinese-English)

您对此问卷的认真填写，将有助于我们的研究工作得出准确的结论，感谢您用耐心和宝贵的时间为管理学研究做出的贡献！此问卷的调查目的是了解中国企业在如何吸收外部的知识以促进内部创新以及问题解决。本问卷为匿名，问卷收回后仅应用于研究目的，并严格保密。如果您对某些问题的答案不确定，选择最符合您猜测或直觉的选项即可。

Thank you for taking the time to finish the questionnaire. By doing so, you make your contribution to science and management study. This study aims to investigate how Chinese SMEs absorb external knowledge to boost internal innovation and solve problems. The questionnaire is anonymous, and we guarantee that the information collected will be used only for academic study. Specific information related to you and your firm will not be made public.

**1. 公司基本信息 General Information of the Firm**

1.1 贵公司年销售额（元） Annual sales of your company (Yuan):

1. < 5 million; 2. 5-10 million; 3. 10-15 million; 4. 15-20 million; 5. 20-25 million;
6. 25-30 million; 7. Above 30 million

1.2 贵公司员工人数 Firm size in terms of the number of employees:

1. < 10; 2. 11-100; 3. 101-300; 4. >300

1.3 贵公司已成立时间（年） Firm age:

1. <5 years; 2. 6-10 years; 3. 11-15 years; 4. 16-20 years; 5. 21-25 years;
6. 26-30 years; 7. >30 years

1.4 贵公司所属行业 Industry your firm belongs to:

1. 化工 Chemical; 2. 钢铁 Steel; 3. 电气设备 Electrical equipment; 4. 计算机 Computer;
5. 机械 Mechanical equipment; 6. 电子 Electronic; 7. 国防军工 Defense military;
8. 汽车 Automobile; 9. 轻工制造 Light industry; 10. 医药生物 Medical biology;
11. 房地产 Real estate; 12. 通信 Communication; 13. 家用电器 Household appliance;
14. 传媒 Media; 15. 交通运 Transportation; 16. 建筑材料 Construction materials;
17. 矿业 Mining; 18. 有色金属 Non-ferrous metals; 19. 商业贸易 Commercial trade;
20. 银行 Bank; 21. 食品饮料 Food and drink; 22. 建筑装饰 Building decoration;
23. 农业 Agriculture; 24. 休闲服务 Leisure service; 25. 纺织服装 Textile and apparel;
26. 公共事业 Public utilities; 27. 非银行金融机构 Non-bank financial institution;
28. 综合 Comprehensive; 29. 其它 Others

## 2. 使用特定知识吸收/创造机制的意愿 **Intention towards Using Certain Knowledge Assimilation/creation Mechanisms**

2.1 当我们需要补充新的知识技能时，我们公司倾向于从我们的同学、朋友、以前的同事、亲戚或社交圈子里的其他熟人那里获取 When we face new opportunities or difficulties in solving internal problems and need to assimilate external knowledge, we often choose to contact our former classmates, former colleagues, friends, relatives or other members within our personal networks for help:

1. 非常不同意 *Strongly disagree*; 2. 不同意 *Disagree*; 3. 不置可否 *Neutral*; 4. 同意 *Agree*;  
5. 非常不同意 *Strongly agree*

2.2 当我们需要补充新的知识技能时，我们公司倾向于通购买授权，或者购买别人的产品或者服务来获取相应的技术或知识的方式来获取 When we face new opportunities or difficulties in solving internal problems and need to assimilate external knowledge, we often choose to get it through licensing, outsourcing research and development (R&D), or buying products or services from the other firms:

1. 非常不同意 *Strongly disagree*; 2. 不同意 *Disagree*; 3. 不置可否 *Neutral*; 4. 同意 *Agree*;  
5. 非常不同意 *Strongly agree*

2.3 当我们需要补充新的知识技能时，我们公司倾向于从开源网站、论坛、搜索引擎、展会、会议等公开渠道或其它宣传资料上获取 When we face new opportunities or difficulties in solving internal problems and need to assimilate external knowledge, we often choose to rely on free sources such as search engines, open-source website, online technical forums, conferences or exhibitions:

1. 非常不同意 *Strongly disagree*; 2. 不同意 *Disagree*; 3. 不置可否 *Neutral*; 4. 同意 *Agree*;  
5. 非常不同意 *Strongly agree*

2.4 当我们需要补充新的知识技能时，我们公司倾向于通过招聘拥有技术或某种知识的员工的方式获取(为了扩大生产招聘新员工或者招聘新员工的目的是为了做一些日常工作不属于此种情况) In our firm, when we face new opportunities or difficulties in solving internal problems and need to assimilate external knowledge, we often choose to hire external expertise or recruit new employees to fill the gap (Recruiting new employees for routine tasks, production expansion, or purposes other than assimilating external or new knowledge is not included):

1. 非常不同意 *Strongly disagree*; 2. 不同意 *Disagree*; 3. 不置可否 *Neutral*; 4. 同意 *Agree*;  
5. 非常不同意 *Strongly agree*

2.5 当我们需要补充新的知识技能时，我们公司倾向于跟已有的供应商或者客户协作，从他们那里获取 When we face new opportunities or difficulties in solving internal problems and need to assimilate external knowledge, we often choose to collaborate with our suppliers and customers to achieve what we want:

1. 非常不同意 *Strongly disagree*; 2. 不同意 *Disagree*; 3. 不置可否 *Neutral*; 4. 同意 *Agree*;  
5. 非常不同意 *Strongly agree*

### 3. 不同的吸收外部知识机制的有效性 **Perceived Effectiveness of Each Knowledge Assimilation Mechanism**

3.1 根据我们公司的经验，从我们的同学、朋友、以前的同事、亲戚或其他熟人那里获取知识和信息的方式 According to my experience in our firm, assimilating external knowledge through former classmates, former colleagues, friends, relatives, or other members within our personal networks is:

1. 非常无效 *Very ineffective*; 2. 无效 *Ineffective*; 3. 中性 *Neutral*; 4. 有效 *Effective*;  
5. 非常有效 *Very effective*

3.2 根据我们公司的经验，通过购买授权或者购买别人的产品或服务的机制来获取相应的技术或知识 According to my experience in our firm, assimilating external knowledge through licensing, outsourcing research and development (R&D), or buying products or services from other firms is:

1. 非常无效 *Very ineffective*; 2. 无效 *Ineffective*; 3. 中性 *Neutral*; 4. 有效 *Effective*;  
5. 非常有效 *Very effective*

3.3 根据我们公司的经验，从开源网站、论坛、搜索引擎、展会、会议等公开渠道或其它宣传资料上获取新知识或技术的方式 According to my experience in our firm, assimilating external knowledge through free and open sources such as search engines, open sources, online technical forums, conferences, or exhibitions is:

1. 非常无效 *Very ineffective*; 2. 无效 *Ineffective*; 3. 中性 *Neutral*; 4. 有效 *Effective*;  
5. 非常有效 *Very effective*

3.4 根据我们公司的经验，通过招聘拥有技术或某种知识的员工的方式获取新知识或技术的方式 According to my experience in our firm, assimilating external knowledge through hiring external expertise or recruiting new employees is:

1. 非常无效 *Very ineffective*; 2. 无效 *Ineffective*; 3. 中性 *Neutral*; 4. 有效 *Effective*;  
5. 非常有效 *Very effective*

3.5 根据我们公司的经验，跟已有的供应商或者客户协作，从他们那里获取所需要的新知识或者技术的方式 According to my experience in our firm, assimilating external knowledge through collaborating with value-chain partners such as our suppliers and customers is:

1. 非常无效 *Very ineffective*; 2. 无效 *Ineffective*; 3. 中性 *Neutral*; 4. 有效 *Effective*;  
5. 非常有效 *Very effective*

#### 4. 陷阱问题 Trap Question

4.1 实现公司员工数量的快速增长对贵公司是否重要 How do you rate the importance of growth in the number of employees to the overall performance of your company?

1. 非常不重要 *Very Unimportant*; 2. 不重要 *Unimportant*; 3. 不置可否 *Neutral*;
4. 重要 *Important*; 5. 非常重要 *Very Important*

#### 5. 公司绩效 Performance

5.1 您对贵公司的以下绩效指标的评价是 How satisfied are you with your firm's current achievement of the following aspects?

##### 现金流 Cash flow:

1. 非常不满意 *Very dissatisfied*; 2. 不满意 *Dissatisfied*; 3. 不置可否 *Neutral*; 4. 满意 *Satisfied*;
5. 非常满意 *Very satisfied*

##### 盈利能力 Profitability ratio:

1. 非常不满意 *Very dissatisfied*; 2. 不满意 *Dissatisfied*; 3. 不置可否 *Neutral*; 4. 满意 *Satisfied*;
5. 非常满意 *Very satisfied*

##### 毛利率 Gross margin:

1. 非常不满意 *Very dissatisfied*; 2. 不满意 *Dissatisfied*; 3. 不置可否 *Neutral*; 4. 满意 *Satisfied*;
5. 非常满意 *Very satisfied*

##### 资产回报率 Return on asset:

1. 非常不满意 *Very dissatisfied*; 2. 不满意 *Dissatisfied*; 3. 不置可否 *Neutral*; 4. 满意 *Satisfied*;
5. 非常满意 *Very satisfied*

##### 销售增长 Sales growth:

1. 非常不满意 *Very dissatisfied*; 2. 不满意 *Dissatisfied*; 3. 不置可否 *Neutral*; 4. 满意 *Satisfied*;
5. 非常满意 *Very satisfied*

##### 市场份额增长 Market share growth:

1. 非常不满意 *Very dissatisfied*; 2. 不满意 *Dissatisfied*; 3. 不置可否 *Neutral*; 4. 满意 *Satisfied*;
5. 非常满意 *Very satisfied*

##### 员工数量增长 Growth in the number of employees:



1. 非常不满意 *Very dissatisfied*; 2. 不满意 *Dissatisfied*; 3. 不置可否 *Neutral*; 4. 满意 *Satisfied*;  
5. 非常满意 *Very satisfied*

5.2 您对以下绩效指标对公司整体绩效的重要程度的评价是 How important is the following achievement to the overall performance of your company?

**现金流 Cash flow:**

1. 非常不重要 *Very Unimportant*; 2. 不重要 *Unimportant*; 3. 不置可否 *Neutral*;  
4. 重要 *Important*; 5. 非常重要 *Very Important*

**盈利能力 Profitability ratio:**

1. 非常不重要 *Very Unimportant*; 2. 不重要 *Unimportant*; 3. 不置可否 *Neutral*;  
4. 重要 *Important*; 5. 非常重要 *Very Important*

**毛利率 Gross margin:**

1. 非常不重要 *Very Unimportant*; 2. 不重要 *Unimportant*; 3. 不置可否 *Neutral*;  
4. 重要 *Important*; 5. 非常重要 *Very Important*

**资产回报率 Return on assets:**

1. 非常不重要 *Very Unimportant*; 2. 不重要 *Unimportant*; 3. 不置可否 *Neutral*;  
4. 重要 *Important*; 5. 非常重要 *Very Important*

**销售增长 Sales growth:**

1. 非常不重要 *Very Unimportant*; 2. 不重要 *Unimportant*; 3. 不置可否 *Neutral*;  
4. 重要 *Important*; 5. 非常重要 *Very Important*

**市场份额增长 Market share growth:**

1. 非常不重要 *Very Unimportant*; 2. 不重要 *Unimportant*; 3. 不置可否 *Neutral*;  
4. 重要 *Important*; 5. 非常重要 *Very Important*

**员工数量增长 Growth in number of employees:**

1. 非常不重要 *Very Unimportant*; 2. 不重要 *Unimportant*; 3. 不置可否 *Neutral*;  
4. 重要 *Important*; 5. 非常重要 *Very Important*

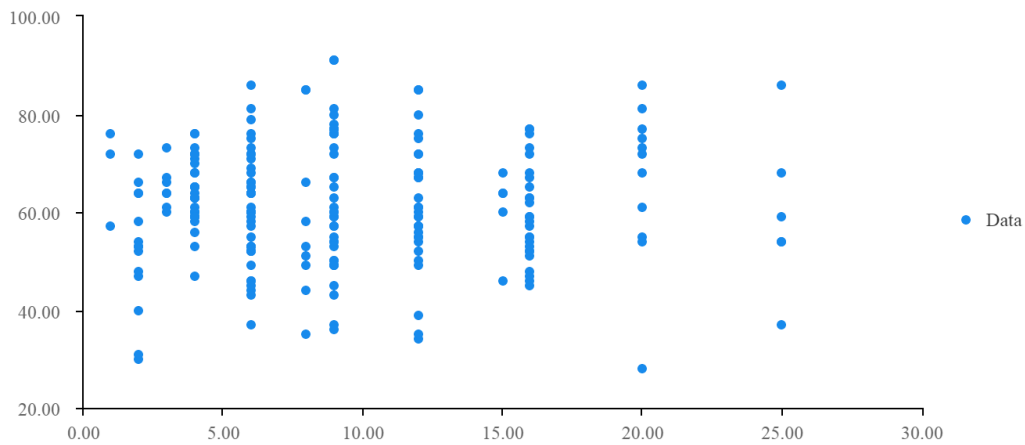
**Appendix 4: Scatter Plots between EKA Mechanisms and SME Performance**

We draw the scatter plots between different EKA mechanisms and SME performance to check possible linear or non-linear relationships between the two variables. We find that neither the assumed linear relationship nor any non-linear relationship patterns are obvious in the plots.

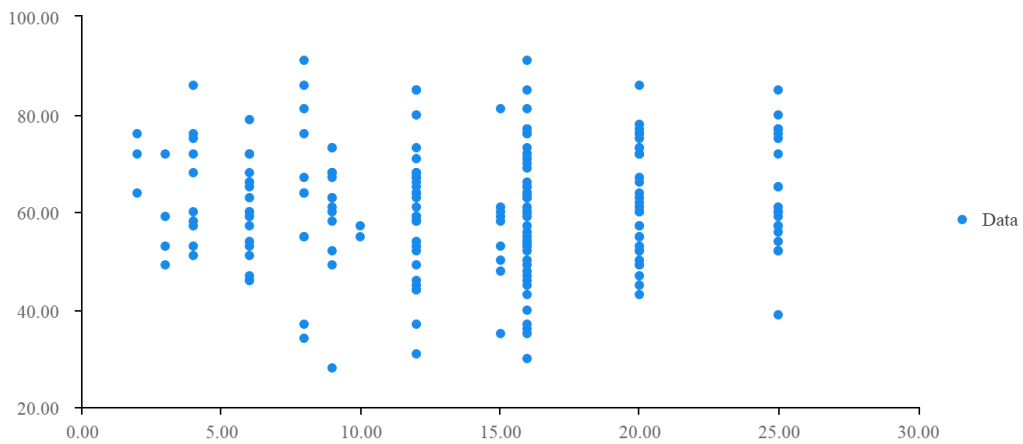
Appendix 4 contains two parts. The first part describes the relationship between the five *EKA mechanisms* and *Financial Performance*. The second part represents the relationship between the *EKA mechanisms* and *Growth Performance*.

**Part 1: Scatter Plots - EKA Mechanisms and Financial Performance**

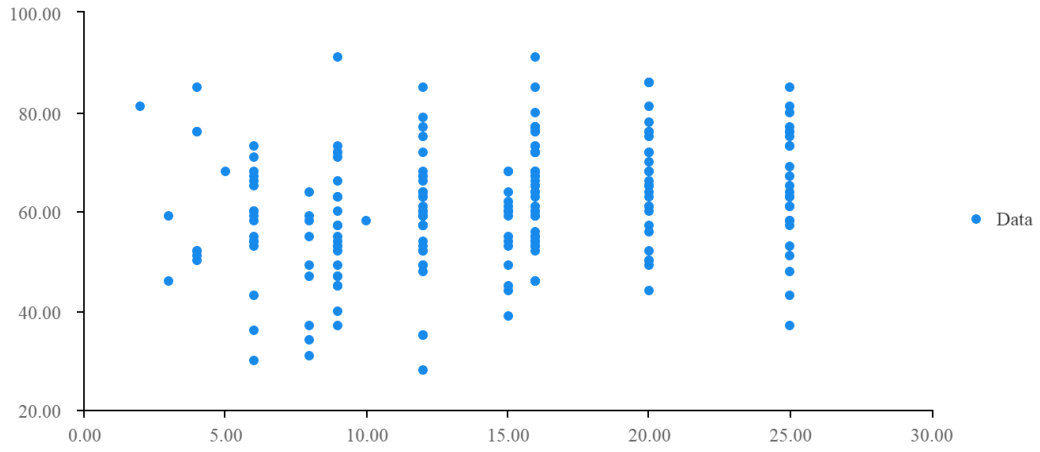
The vertical axis represents the Financial Performance, and the horizontal axis indicates different EKA mechanisms in the following plots.



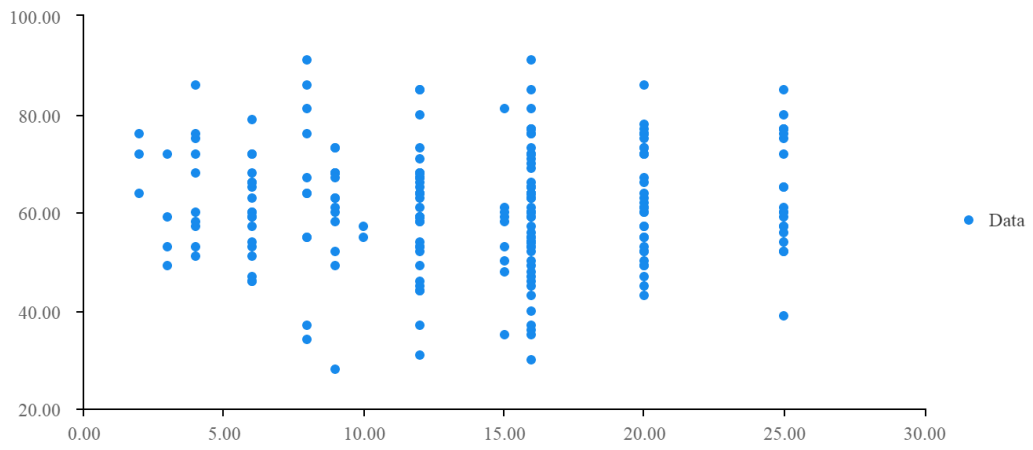
EKA 1 Personal Networks vs. Financial Performance



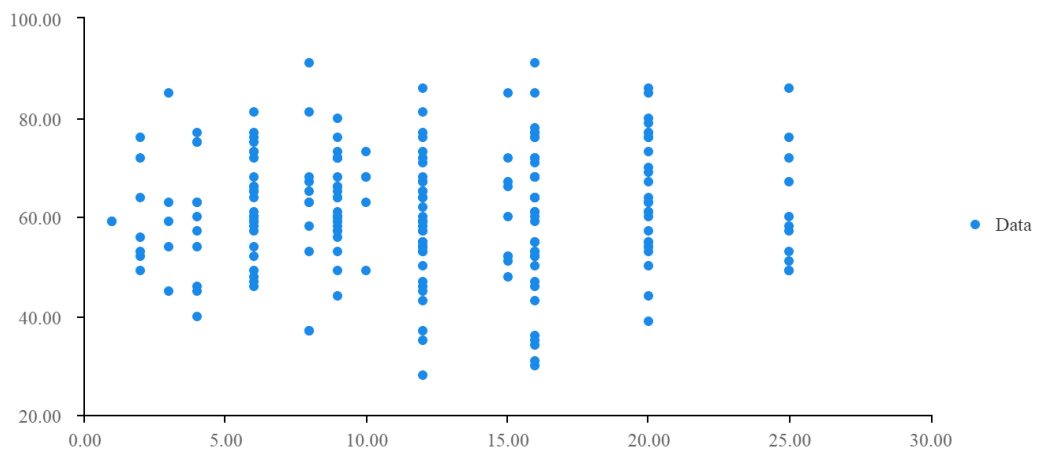
EKA 2 Purchase vs. Financial Performance



EKA 3 Free Sources vs. Financial Performance



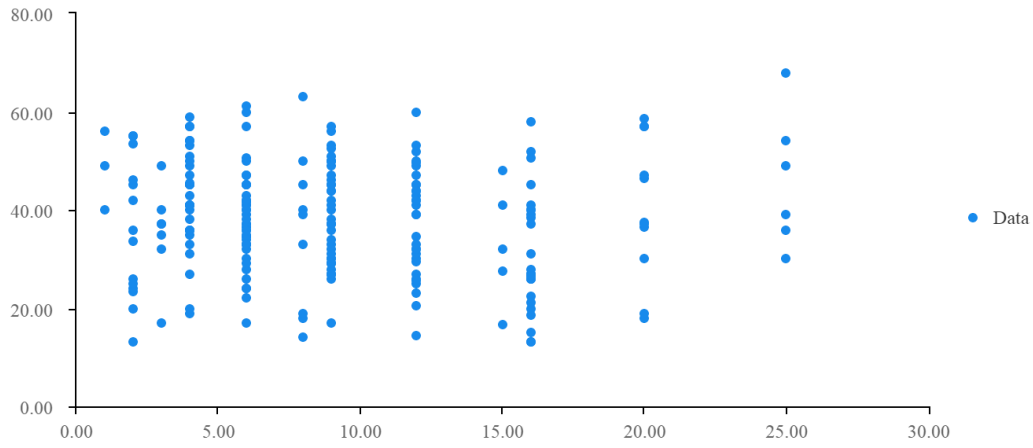
EKA 4 Recruiting vs. Financial Performance



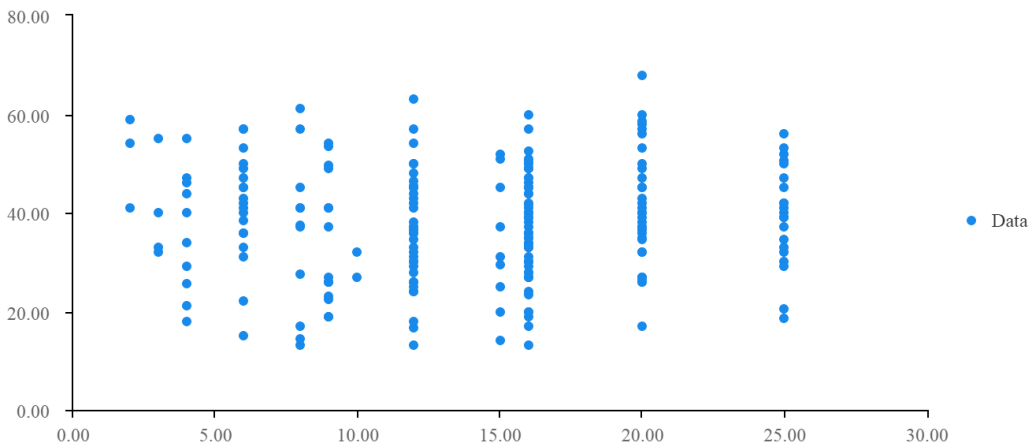
EKA 5 Value-chain Partners vs. Financial Performance

**Part 2:** Scatter Plots - EKA Mechanisms and Growth Performance

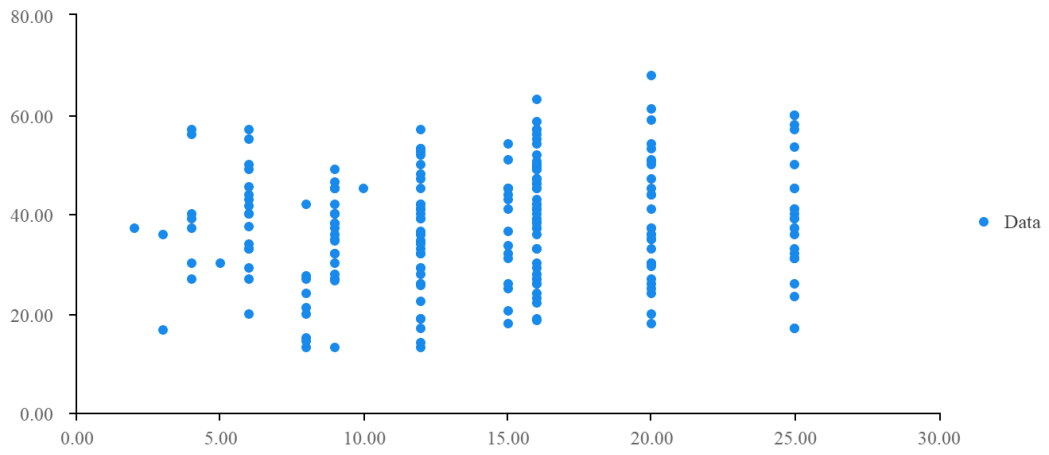
The vertical axis represents the Growth Performance, and the horizontal axis indicates different EKA mechanisms in the following plots.



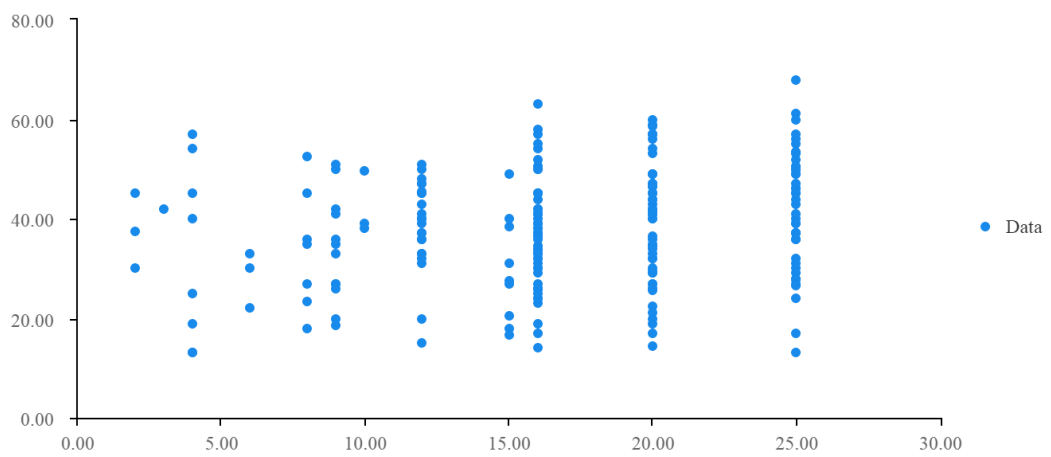
EKA 1 Personal Networks vs. Growth Performance



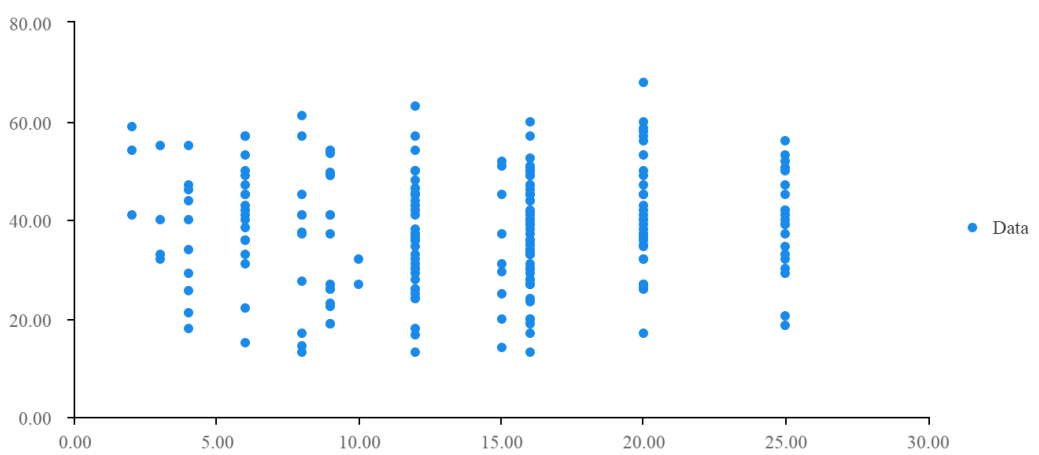
EKA 2 Purchase vs. Financial Performance



EKA 3 Free Sources vs. Growth Performance



EKA 4 Recruiting vs. Growth Performance



EKA 5 Value-chain Partners vs. Growth Performance

### Appendix 5: Effects of Different EKU Purposes

The following two tables show our regression analysis results between different EKU purposes and firm performance (*Financial Performance* and *Growth Performance*). We run two regression analyses accordingly. Both regression models and some independent variables in the models are significant, indicating that the EKU purposes do make differences in firm performance.

Regression between SME financial performance and different EKU purposes

Variable	B	Sdt. Error	Beta	t	p	VIF	R <sup>2</sup>	Adj. R <sup>2</sup>	F
(Constant)	40.253	9.247	-	4.353	0.000**	-			
Employee Number	-4.808	3.014	-0.206	-1.595	0.118	1.228			
Firm Age	2.053	1.519	0.178	1.351	0.184	1.269			
Annual Sales	0.32	0.698	0.062	0.458	0.649	1.335			
Quality Improvement	0.121	0.268	0.057	0.454	0.653	1.151	0.442	0.334	4.065**
Problem Solving	0.378	0.274	0.203	1.383	0.174	1.579			
Expertise Concentration	0.488	0.259	0.246	1.886	0.066	1.247			
Time Saving	0.181	0.232	0.105	0.778	0.441	1.335			
Cost Saving	0.566	0.232	0.314	2.443	0.019*	1.215			

D-W value:1.854 \* p<0.05 \*\* p<0.01

Regression between SME growth performance and different EKU purposes

Variable	B	Sdt. Error	Beta	t	p	VIF	R <sup>2</sup>	Adj. R <sup>2</sup>	F
(Constant)	11.278	10.632	-	1.061	0.295	-			
Employee Number	3.599	3.466	0.147	1.038	0.305	1.228			
Firm Age	-1.705	1.747	-0.141	-0.976	0.335	1.269			
Annual Sales	1.054	0.802	0.194	1.313	0.196	1.335			
Quality Improvement	0.382	0.308	0.17	1.242	0.221	1.151	0.329	0.199	2.517*
Problem Solving	-0.434	0.315	-0.222	-1.38	0.175	1.579			
Expertise Concentration	0.678	0.297	0.326	2.28	0.028*	1.247			
Time Saving	0.058	0.267	0.032	0.216	0.83	1.335			
Cost Saving	0.739	0.266	0.391	2.772	0.008**	1.215			

D-W value:2.240 \* p<0.05 \*\* p<0.01

## **Acknowledgment**

This dissertation is a result of my working within the Network of IT and Innovation Management (NiTiM) projects. It would not have been finished without the supports of many people. The late Professor Bernhard Katzy admitted me to the doctorate program and introduced me to the academic world. Dr. Roland Ortt guided me along the study's whole trajectory as my tutor and academic supervisor since the early stage of my Ph.D. study. He spent a substantial part of his valuable time holding regular meetings in the past six years to discuss my research and give advice. He helped me formulate the study's shape and provided me with much encouragement and support when I faced obstacles. I am grateful to Professor Kristin Paetzold, who continuously funded me for almost one year when the initial project has ended. My further appreciations go to Professor Jaap van den Herik, who has taken over the role of being my promotor from the late professor Bernhard Katzy. The friendship between the two professors allowed me to continue my Ph.D. study smoothly without any administrative interruptions. Professor Jaap van den Herik has also spent a considerable amount of time reading and correcting the dissertation.

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While the journey of pursuing a Ph.D. might be a trip alone for many people, I never felt so, as I have been cooperating with many talented individuals. We have participated in the same project and met similar difficulties and struggles. Thanks to the NiTiM

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