Figure 1 Exchange Options

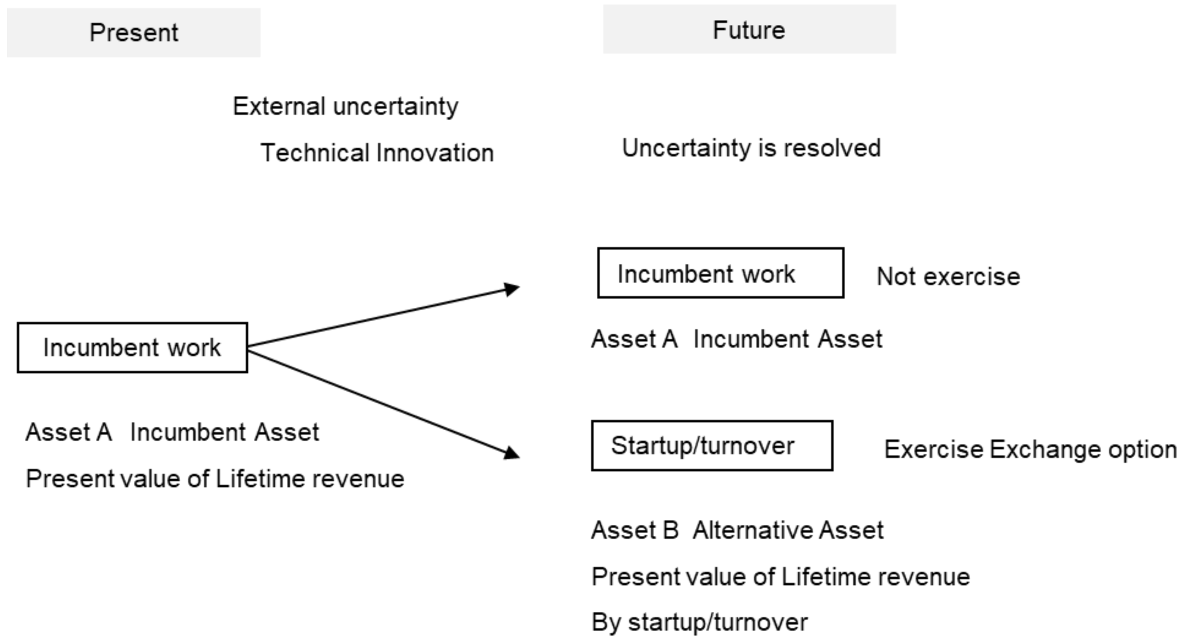

Figure 2 Model

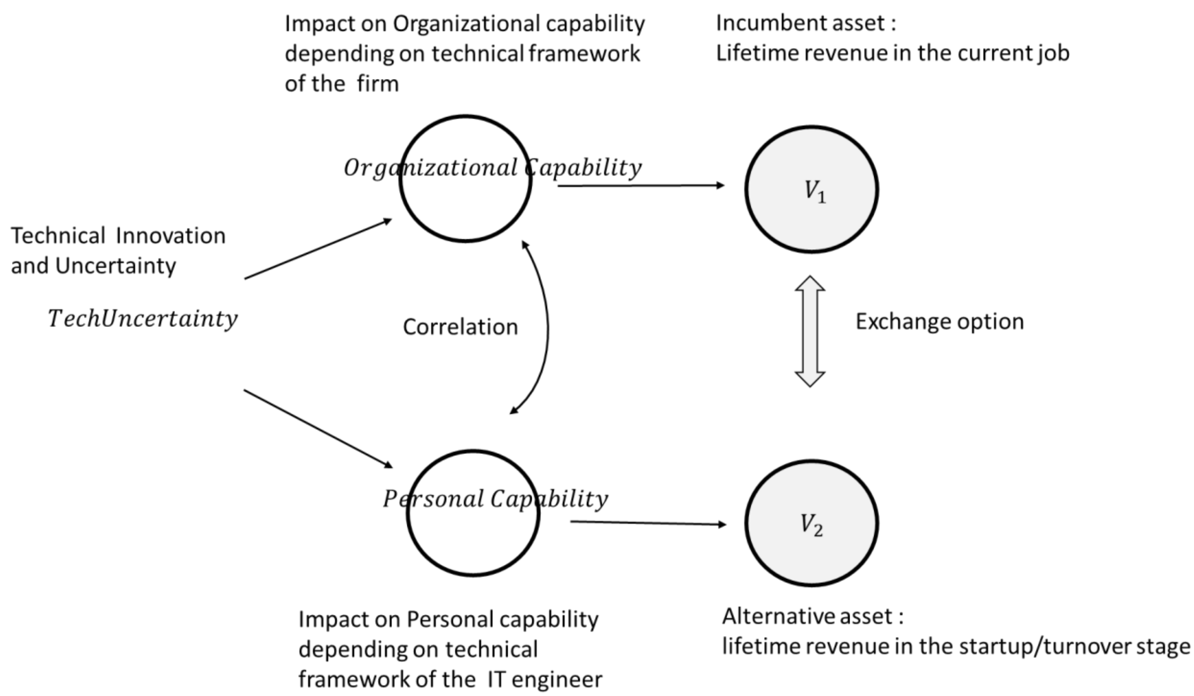

Table 1 Impact of Technological Innovation

	opportunity (Likert scale)	threat (Likert scale)	growth rate estimate	volatility estimate
Company Capability	[Opportunities by Tech innovation]	[Threats by Tech innovation]	$Drift_1$	$Volatility_1$
	New technology O_{n1}	New technology T_{n1}	$O_{n1}-T_{n1}$	$\lvert O_{n1}+T_{n1}\rvert$
	Cloud computing O_{n2}	Cloud computing T_{n2}	$O_{n2}-T_{n2}$	$\lvert O_{n2}+T_{n2}\rvert$
	SaaS O_{n3}	SaaS T_{n3}	$O_{n3}-T_{n3}$	$\lvert O_{n3}+T_{n3}\rvert$
	M2M (IOT) O_{n4}	M 2 M (IOT) T_{n4}	$O_{n4}-T_{n4}$	$\lvert O_{n4}+T_{n4}\rvert$
	Tablets O_{n5}	Tablets T_{n5}	$O_{n5}-T_{n5}$	$\lvert O_{n5}+T_{n5}\rvert$
	Open source O_{n6}	Open source T_{n6}	$O_{n6}-T_{n6}$	$\lvert O_{n6}+T_{n6}\rvert$
	Smartphone O_{n7}	Smartphone T_{n7}	$O_{n7}-T_{n7}$	$\lvert O_{n7}+T_{n7}\rvert$
Engineer Personal capabilities	[Opportunities by Tech innovation]	[Threats by Tech innovation]	$Drift_2$	$Volatility_2$
	Increase tech skills S_{n1}	Obsolete technical skill W_{n1}	$S_{n1}-W_{n1}$	$\lvert S_{n1}+W_{n1}\rvert$
	Cloud S_{n2}	Cloud W_{n2}	$S_{n2}-W_{n2}$	$\lvert S_{n2}+W_{n2}\rvert$
	SaaS S_{n3}	SaaS W_{n3}	$S_{n3}-W_{n3}$	$\lvert S_{n3}+W_{n3}\rvert$
	M2M (IOT) S_{n4}	M2M (IOT) W_{n4}	$S_{n4}-W_{n4}$	$\lvert S_{n4}+W_{n4}\rvert$
	Tablets S_{n5}	Tablets W_{n5}	$S_{n5}-W_{n5}$	$\lvert S_{n5}+W_{n5}\rvert$
	Open source S_{n6}	Open source W_{n6}	$S_{n6}-W_{n6}$	$\lvert S_{n6}+W_{n6}\rvert$
	Smartphone S_{n7}	Smartphone W_{n7}	$S_{n7}-W_{n7}$	$\lvert S_{n7}+W_{n7}\rvert$

NOTES

1. The n^{th} IT engineer answers questionnaires on "opportunities." $O_{n1}, O_{n2}, O_{n3} \cdots O_{n7}$, and "threats" $T_{n1}, T_{n2}, T_{n3} \cdots T_{n7}$ of the firms they are employed, and the questionnaires about his personal capability in the light of "opportunities" $S_{n1}, S_{n2}, S_{n3} \cdots S_{n7}$ and "threats" $W_{n1}, W_{n2}, W_{n3} \cdots W_{n7}$, caused by each IT innovation elements.
2. The drift rate ($Drift_1$) of the capabilities of the firm are gained estimated through the average of differences in each questionnaires ; $O_{n1} - T_{n1}, O_{n2} - T_{n2}, \cdots O_{n7} - T_{n7}$, while the volatility ($Volatility_1$) is estimated through the average of absolute sum; $|O_{n1} + T_{n1}|, |O_{n2} + T_{n2}| \cdots |O_{n7} + T_{n7}|$. Similarly, the drift of the personal capabilities ($Drift_2$) is gained from the average; $S_{n1} - W_{n1}, S_{n2} - W_{n2}, \cdots S_{n7} - W_{n7}$, while volatility ($Volatility_2$) is gained; $|s_{n1} + W_{n1}|, |S_{n2} + W_{n2}| \cdots |S_{n7} + W_{n7}|$,
3. The correlation coefficient between the personal and organizational capability growth is calculated from the combinations of each personal and organizational "opportunity" and "threat" scale; $(S_{n1}, O_{n1}), (S_{n2}, O_{n2}) \cdots (S_{n7}, O_{n7})(W_{n1}, T_{n1}), (W_{n2}, T_{n2}) \cdots (W_{n7}, T_{n7})$.
4. The Cronbach's alpha coefficients of each composite variables are as follows.

   $\alpha Drift_1 = 0.85$ $\alpha Volatility_1 = 0.89$ $\alpha Drift_2 = 0.91$ $\alpha Volatility_2 = 0.92$

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Appendix 1 Table a1 Logistic Regression Analysis Result I (All IT Engineers)

	Logistic regression 1.1		Logistic regression 1. 2	
Independent variable	Turnover OPN 5		Startup OPN 5	
SEX	0.127 (0.239)		−0.073 (0.295)	
WorkYear_Ln	0.428 * (0.170)	0.459 ** (0.154)	0.107 (0.187)	
Ln_Income	−0.245 (0.170)		0.073 (0.198)	
School_Sci	−0.089 (0.138)		−0.163 (0.163)	
SME	−0.109 (0.143)		0.142 (0.167)	
Skill_ln IT skills	0.090 (0.120)		0.253 (0.138)	0.230 (0.109)
Knowledge_In Business knowledge	0.108 (0.120)		0.005 (0.138)	
Network Human network	0.182 (0.100)	0.178 (0.095)	0.656 *** (0.121)	0.665 *** (0.117)
$Drift_1$	0.084 (0.099)		0.232 (0.119)	0.193 (0.111)
$Drift_2$	−0.048 (0.093)		−0.057 (0.111)	
Correlation coefficient	−0.559 ** (0.177)	−0.545 ** (0.174)	−1.013 *** (0.213)	−1.011 *** (0.211)
$Volatility_1$	0.020 (0.087)		0.105 (0.102)	
$Volatility_2$	0.248 ** (0.077)	0.259 *** (0.056)	0.166 (0.091)	0.220 ** (0.067)
constant	−2.562 (1.439)	−3.761 *** (0.632)	−5.463 ** (1.683)	−4.428 *** (0.513)
NagelKerke R^2	0.077 1305.493 1026	0.069 1312.009 1026	0.141 1022.139 1026	0.136 1025.772 1026

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

NOTE SEX means gender (female = 1), WorkYer_ln is the residual year up to 65 years of age, log-transformed. The log-transformed median of the income range is Ln_Income. School_Sci is dummy variables identifying science education. SME is the dummy variable, meaning working for small and medium sized enterprise (SME = 1).

Table a2 Logistic Regression II (IT Engineers Engaged in System Development)

	Turnover OPN5	Startup OPN5
Skill_ln	−0.093 (0.148)	0.227 (0.166)
Knowledge_In	−0.064 (0.142)	−0.201 (0.161)
Network	−0.175 (0.117)	0.722 *** (0.141)
Opportunity	0.356 ** (0.114)	0.452 ** (0.138)
Legacy	−0.223 (0.263)	−0.394 (0.294)
Downstream	−0.281 (0.228)	−0.398 (0.267)
constant	−1.219 * (0.523)	−3.772 *** (0.642)
NagelKerke R^2	0.036	0.119
Deviance	859.611	690.360
N	647	647

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

Appendix 2 Margrabe(1978) exchange option valuation model

$$OptionValue = V_2 N(d_1) - (1+K)V_1 N(d_2)$$

$$d_1 = \frac{ln\left[\frac{V_1}{(1+K)V_2}\right] + T\frac{\sigma^2}{2}}{\sigma\sqrt{T}} \quad d_2 = \frac{ln\left[\frac{V_1}{(1+K)V_2}\right] - T\frac{\sigma^2}{2}}{\sigma\sqrt{T}}$$

V_2 is the value of alternative asset after option exercise and V_1 is the value of the incumbent assets. The volatility of the assets is σ_1,σ_2. The correlation coefficient of the two assets is ρ. It is assumed that the interest rate is zero and that the two risky assets follow correlated (correlation coefficient ρ) geometric Brownian motions with the drift rate (the growth rate) μ_1 , μ_2.

$$\frac{dV_1}{V_1} = \mu_1 dt + \sigma_1 dz$$

$$\frac{dV_2}{V_2} = \mu_2 dt + \sigma_2 dz$$

$$\sigma^2 = \sigma_1^2 + \sigma_2^2 - 2\rho\sigma_1\sigma_2$$

The exchange-option would be exercised if $V_2 > (1+K)V_1$, where K is the switching cost. The integrated uncertainty σ increases accordingly with σ_1、 σ_2 and decreases with a positive correlation.