Doc2vec 기반 협업 필터링과 요인분석을 활용한 인수합병 대상 스타트업 추천 시스템

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Contents

빠른 기술 변화

기술 기반 M&A

✓ M&A를 통한 기술력 확보는,

- 기업의 성장과 개발의 중요한 대안이자 원동력(Bauer & Matzler 2014).
- R&D의 비용과 리스크를 감소시킴(Wang, 2009).
- 급진적이고 파괴적인 혁신을 이끌 확률이 높음(Basu & Wadhwa, 2013)
- 독특한 지식과 새로운 기술을 탐구하는데 효과적(Stettner & Lavie, 2014)

기업의 기술 경쟁력을 확보, 경쟁에서 우위를 차지하는 데 있어 M&A는 매우 효율적

성장 전략에 부합하는 후보 기업들은 성공적인 M&A를 이끄는 열쇠!

✓ **유사한 기술 기반의 수직적(vertical) M&A**

- 규모의 경제, 시장에서의 범위를 넓히기
  (Bertrand & Zungia, 2006; Bauer & Matzler, 2014; Cassiman et al., 2005).
- 미래에 발생가능한 경쟁을 미리 막아 시장을 독점
  (O'Donoghue et al., 1998; Grimpe & Hussinger, 2008b).
- 시장 점유율, 부가가치 증가
  (Datta & Roumani, 2015)

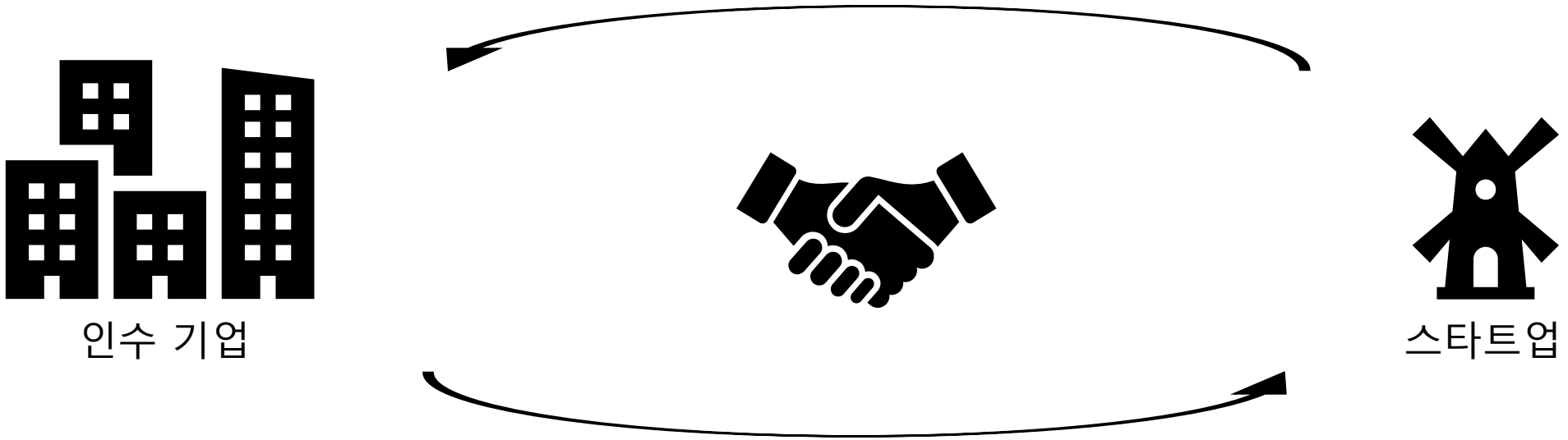
✓ **보조적 기술 기반의 수평적(horizontal) M&A**

- 기술 포트폴리오를 넓혀 새로운 기회를 모색
- 보유 기술 자원들을 재배치하여 혁신 증진
  (Cassiman et al., 2005; Hussinger, 2005; Sorescu et al., 2007).

- **자원 기반 M&A는, M&A가 실제로 이루어질 확률도 높아진다(Wang and Zajac, 2007).**
- **합병 이후의 기업의 성과에도 긍정적인 영향을 끼친다(Cartwright, 2006; Chatterjee, 2009).**

스타트업은 탁월한 M&A 후보군(Kohler, 2016; Weiblen & Chesbrough, 2015).

- 새로운 아이디어, 혁신(Pauwels et al., 2016), 지식(Dushnitsky & Shaver, 2009), 기술, 시장 통찰력 (Siegel et al., 1988), 접근 방법(Ahuja & Morris Lampert, 2001)에 대한 영감.



- 인력, 제품 개발 등의 필수적인 자원 지원(Alvarez & Barney, 2001; Kohler, 2016).
- 노하우, 시장에서의 명성, 신뢰도(Baum et al., 2000).

Introduction

- 모든 대상 기업들을 직접 실사하여 탐사하는 것은 시간과 자원 측면에서 낭비이다.
- 이전 연구들은 보유 특허를 분석하여 대상 기업의 기술적 위치를 탐색하여 적절한 M&A 대상 후보군을 선정하였다(Huang et al., 2015; Park et al., 2013; Saviotti et al., 2005).

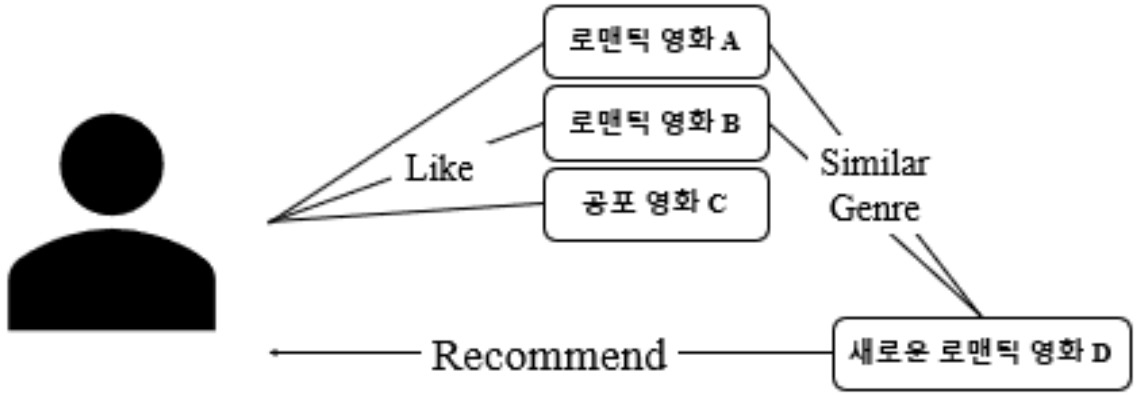
Patent Text

하지만, 신생 스타트업은 기술적 위치 규명이 어렵다!

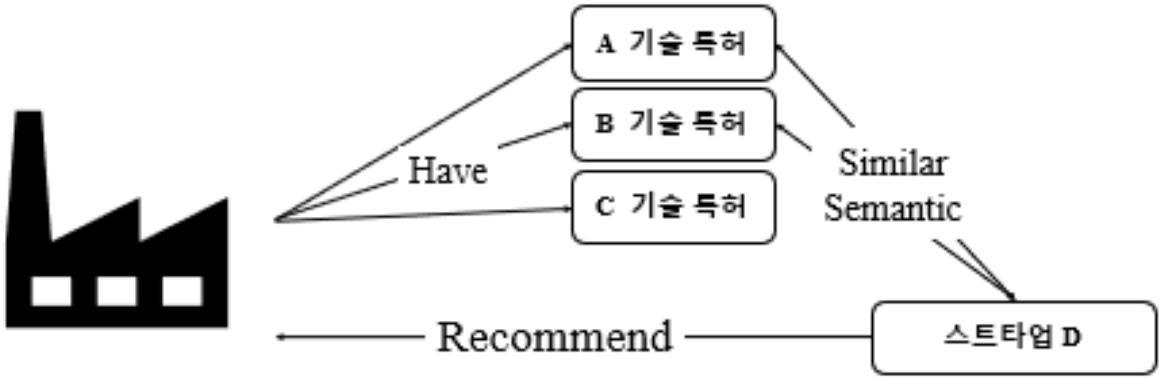
본 연구에서는,

- 인수기업의 특허의 초록(USPTO)과 인수대상 스타트업 프로필 소개글(Crunchbase)을 바탕으로, Doc2vec 기반 협업 필터링과 요인분석을 활용한 인수합병 대상 스타트업 추천 시스템을 제안한다.
- 4차 산업혁명에서 유망 기술인 VR/AR 관련 기업과 스타트업들에 대해 적용하여, 2가지 M&A 전략과 4가지 스타트업 유망성 측면에서 추천된 스타트업들을 관찰한다.

Methodology – 아이템 기반 협업 필터링(IBCF) (Linden et al, 2003).



<Movie Recommendation using IBCF>



<Startup Recommendation using IBCF>

- **아이템 기반 협업필터링(IBCF): 특정 아이템을 좋아했다면, 그 아이템과 비슷한 아이템을 추천**

  ex) 특정 사용자가 좋아한 영화의 목록이 주어졌을 때, 이 영화들과 유사한 다른 영화들을 추천.

본 연구는,

인수 기업이 보유한 특허의 목록이 주어졌을 때, 이 특허들과 유사한 스타트업들을 추천.

Methodology – 아이템 기반 협업 필터링(IBCF)

User	Avengers	Sherlock	Superman
Alex	1	0	0
Bell	1	0	1
Charles	0	0	1
David	0	1	1
Ellen	0	1	0

User/Item matrix

*

	Avengers	Sherlock	Superman
Avengers	1	0.1	0.8
Sherlock	0.1	1	0.3
Superman	0.8	0.3	1

Item Similarity matrix

=

User	Avengers	Sherlock	Superman
Alex	👁	0.1	0.8
Bell	👁	0.4	👁
Charles	0.8	0.3	👁
David	0.9	👁	👁
Ellen	0.1	👁	0.3

"Recommendation Score"

Methodology – 아이템 기반 협업 필터링(IBCF)

특허와 스타트업은 동일한 차원의 item으로 고려

Company	Patent1	Patent2	Patent3
	1	0	0
SAMSUNG	0	1	0
amazon	0	0	1

User/Item matrix

*

	Startup1	Startup2
Patent1	0.9	0.5
Patent2	0.1	0.9
Patent3	0.8	0.2

Item Similarity matrix

=

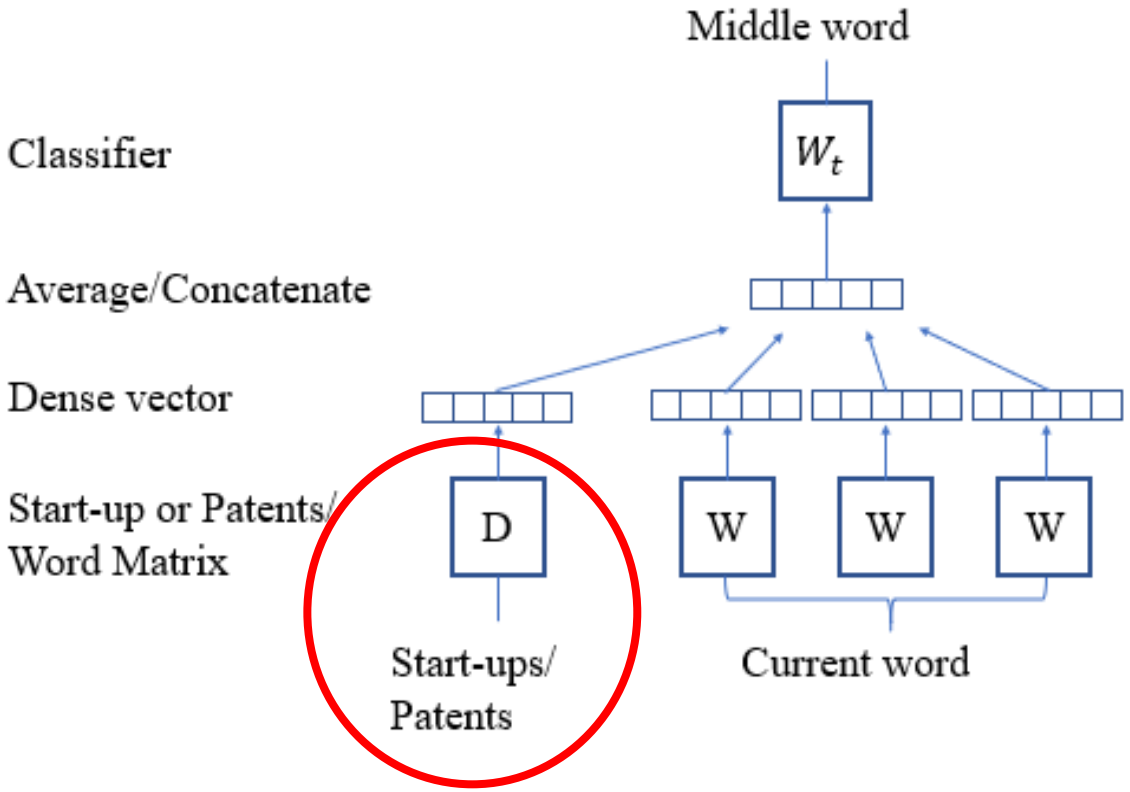
Company	Startup1	Startup2
	0.9	0.5
SAMSUNG	0.1	0.9
amazon	0.8	0.2

"Recommendation Score"

Methodology – Doc2vec (Le & Mikolov, 2014)

ISL@YONSEI Industrial Statistics Lab

특허/스타트업 텍스트 벡터화



특허 초록(USPTO - Wisdomain)

(19) **United States**
(12) **Patent Application Publication**
Conlon et al.

(10) **Pub. No.: US 2009/0082171 A1**
(43) **Pub. Date: Mar. 26, 2009**

(54) **OUTPUT SPLIT ELECTRICALLY-VARIABLE TRANSMISSION WITH ELECTRIC PROPULSION USING ONE OR TWO MOTORS**

(75) Inventors: **Brendan M. Conlon**, Rochester Hills, MI (US); **Peter J. Savagian**, Bloomfield Hills, MI (US); **Alan G. Holmes**, Clarkston, MI (US); **Michael O. Harpster, JR.**, Oakland Township, MI (US)

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Publication Classification

(51) **Int. Cl.**
F16H 3/72 (2006.01)
B60K 1/00 (2006.01)

(52) **U.S. Cl.** **477/5**; 180/65.7

(57) **ABSTRACT**

An electrically-variable transmission is provided with input member and output member, first and second motor/genera-tors, a first planetary gear set and a final drive gearset. Two or three torque-transmitting mechanisms that are selectively

스타트업 프로필(CrunchBase)

Habiteo
Real estate innovation to drive your profitability : sales and marketing end-to-end platform
Paris, Ile-de-France, France

Categories	3D Technology, CRM, Property Development, Real Estate, Virtual Reality
Headquarters Regions	European Union (EU)
Founded Date	Jun 2014
Founders	Denis Fayolle, Jean-claude Szaleniec, Jeanne Massa, Julien Frelat
Operating Status	Active

1st collaborative platform that simultaneously manages sales and marketing activities to build a tailored customer relationship.

True "sales booster", Habiteo builds a link between · 3D marketing tools · Customer relationship · and marketing.

In 2014, Habiteo was born from a simple observation: selling on plan is 1. complex whether face to face or remote. 2. expensive.

Then, we developed our own technology and in 3 years we democratized 3D in real estate development and make it "the standard" in this sector by fully digitizing the customer journey.

Today 3D allows · the future buyer to project himself, to have a crush, to live an immersive buying experience. · the seller to spotlight his program, to get to know his prospect better and to become an expert advisor.

3D really helps to better qualify prospects' need. But if this 3D works with a customer relationship management tool and business management, it can accelerate the sales cycle.

It's all about putting the customer in the center of the attention and allowing the team to do what it does best : sell!

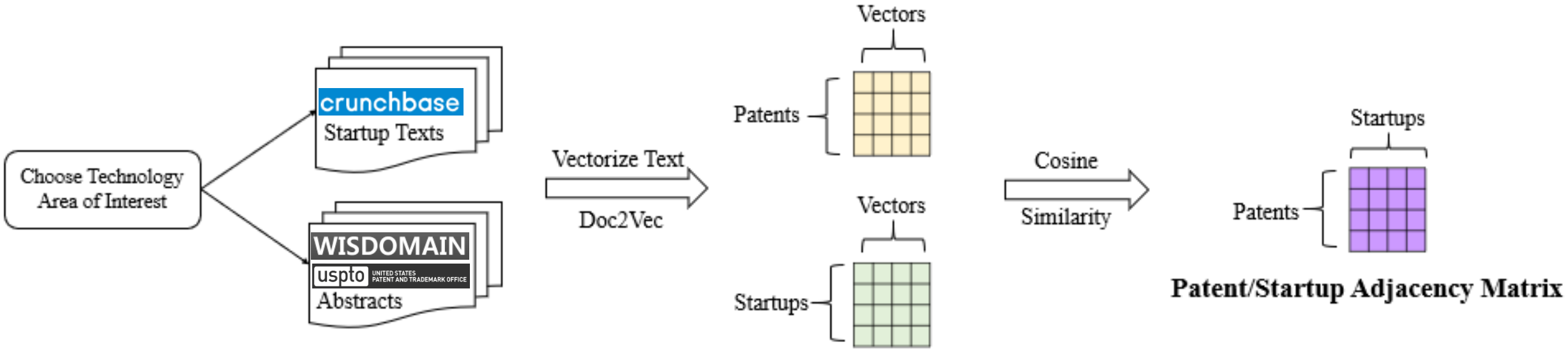
In 2018, Habiteo launched myHabiteo : a collaborative platform to drive sales and marketing activities and build a bespoke customer relationship.

Our innovation? To find on one single platform the simultaneous management of :

· your marketing and 3D elements and their performance · your program information and their performance · your customer relationship and its performance · your internal and external users and their performance

Our objective ? Bring the real estate innovation to help you drive your profitability.

Framework - 특허/스타트업 유사도 행렬 계산



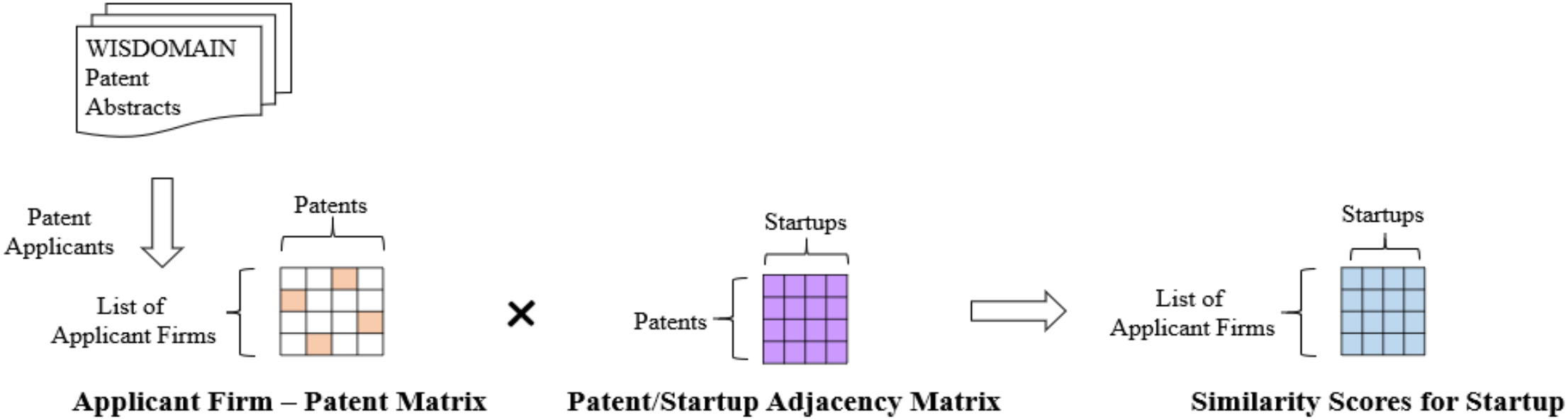
✓ **스타트업 DB CrunchBase**

- 다양한 스타트업의 프로필을 보유한 가장 큰 DB(Tarasconi & Menon, 2017; Liang & Yuan, 2016).
- 200개가 넘는 국가에서 65만명의 개인과 40만개가 넘는 기업들이 등록(Nathan et al., 2017),
- 기업의 이름, 위치, 설립일, CEO의 성별,… (Dalle et al., 2017; Tarasconi & Menon, 2017).
- 투자자들이나 연구자들에게 좋은 정보 소스(Dalle et al., 2017; Tarasconi & Menon, 2017).

✓ **Cosine Similarity**

$$cos(\theta) = \frac{A \cdot B}{\|A\|\|B\|} = \frac{\sum_{i=1}^{n} A_i B_i}{\sqrt{\sum_{i=1}^{n} A_i^2}\ \sqrt{\sum_{i=1}^{n} B_i^2}}$$

Framework – 기업별 스타트업 기술적 유사도 점수



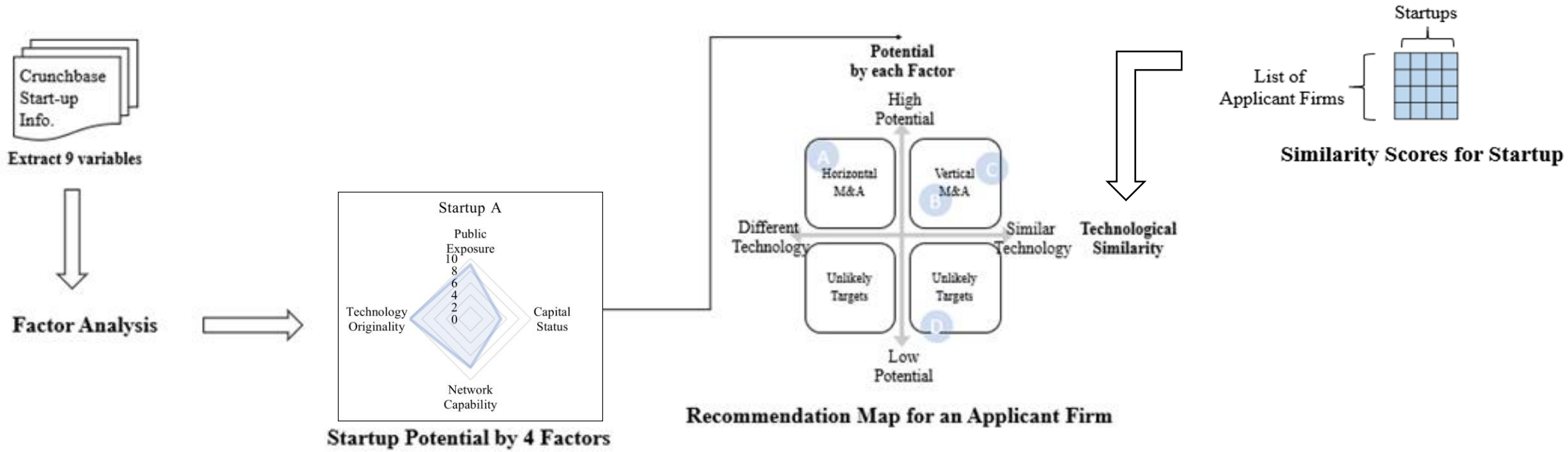
✓ **인수 기업-특허 행렬(Applicant Firm-Patent Matrix):**

- 특허 출원기업을 열에, 특허 보유정보를 행에 배치하여 User-Item 행렬을 구성(특허 보유시 1, 그렇지 않으면 0)

✓ **기술적 유사도 점수(Similarity Score)**

- 각 기업이 보유한 특허 정보들을 종합하 여각 스타트업들과의 기술적 유사도 점수 도출(MIN-MAX 정규화로 0-10점)
- 5점 이상일 경우 **수직적 M&A**, 5점 이하일 경우 **수평적 M&A** 전략 대상 스타트업으로 분류.

Framework – 기업별 스타트업 추천맵



✓ **스타트업 유망성 평가**

- 스타트업 유망성 평가에 사용할 9가지의 변수의 가중치를 도출하기 위하여 요인분석를 실시.
- ***Public Exposure, Captial Status, Technology Originality, Network Capability*** 요인별로 점수화.

✓ **인수기업 당 유망성 요인-기술적 유사도 점수를 이용하여 스타트업을 추천맵을 생성**

VR/AR 기술은 차세대 ICT 시장의 핵심 기술이자 변화의 큰 동력이 될 것
(한국과학기술기획평가원, 2018; Gartner 보고서, 2018).

데이터 수집

- 특허 초록 (USPTO - Wisdomain): VR/AR 관련 7005개의 특허 수집
- 스타트업 프로필 소개글 (Crunchbase): VR/AR 관련 2274개의 스타트업 수집

87개의 기업(약 4%)만이 특허 보유

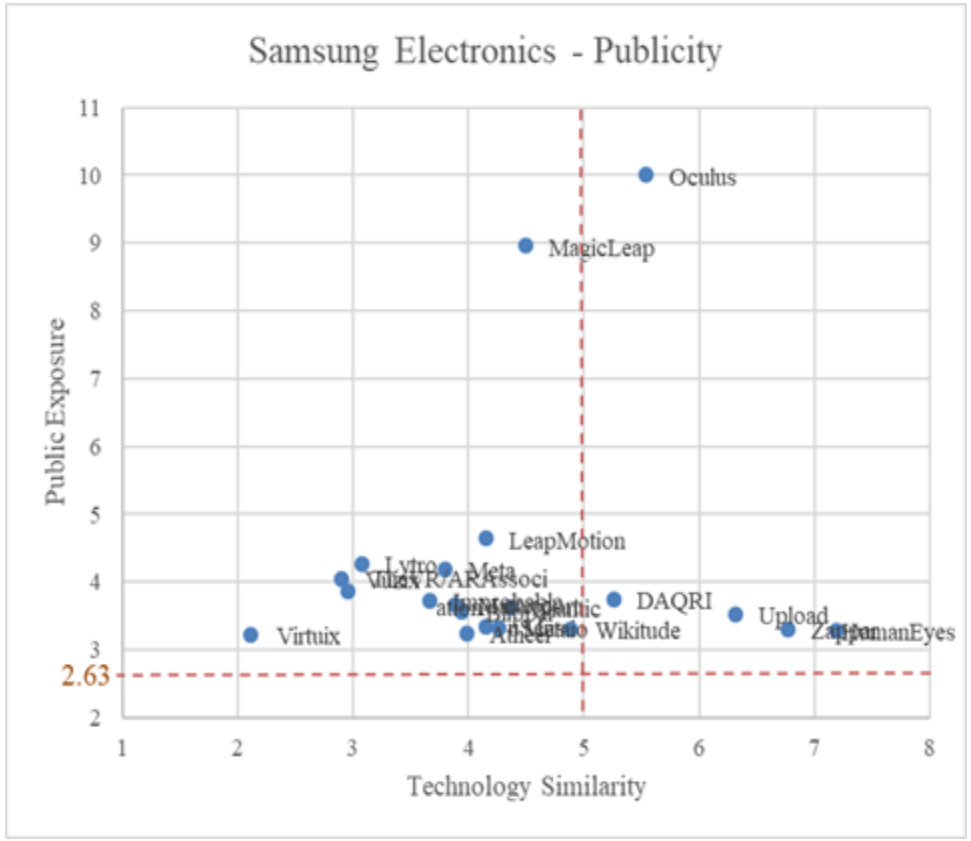
데이터 전처리

- 인수 주체 기업들의 **특허 초록**과 스타트업 **프로필 소개글**에는 텍스트의 특징을 나타내는 단어들이 아닌 관사, 지시대명사들은 제외하고 **명사, 동사, 형용사 등 만을 핵심 품사**로 이용하여 프레임워크에 적용하였다.

Doc2vec

- 기업의 특허와 스타트업에 문서 ID를 할당하여 텍스트 내의 단어들을 바탕으로 분석을 실시하였다.
- 벡터의 차원은 **400차원**, 윈도우 사이즈는 **5**, 학습 반복횟수는 **100회**로 설정.

Public Exposure 측면의 스타트업 추천맵 – 삼성전자



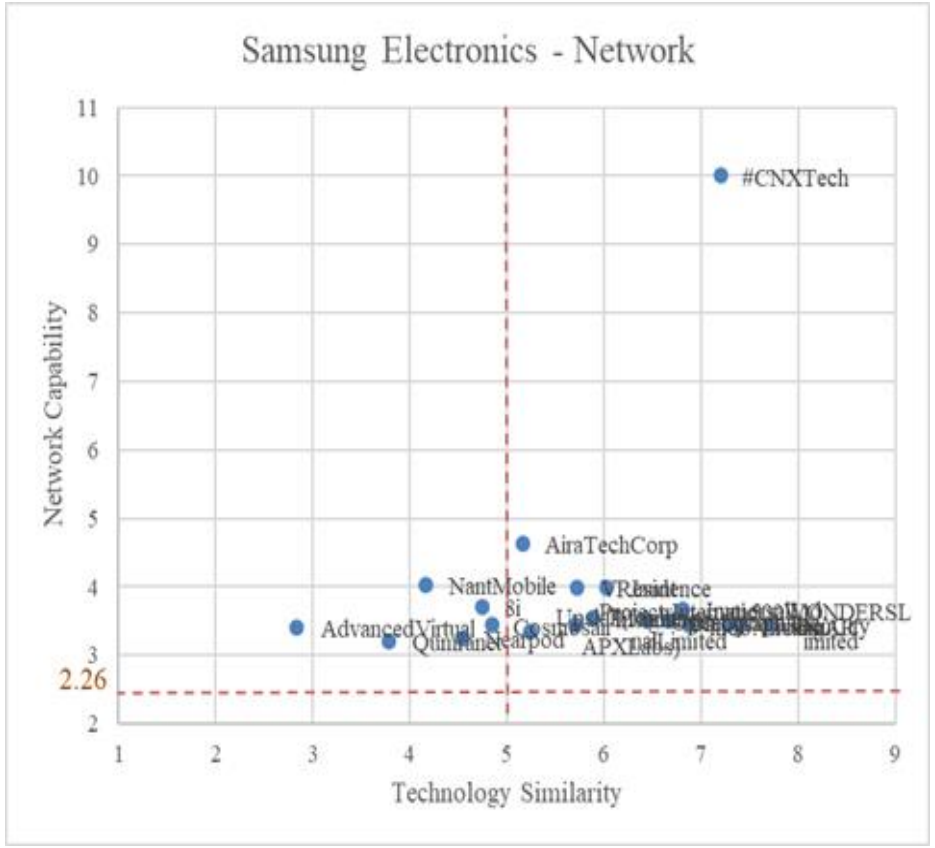
수직 M&A 대상 스타트업

Upload, Zappar, HumanEyes은 어플리케이션이나 기기 등을 통해 서비스를 제공하고 사용자들을 모아 마케팅 기회를 찾으려는 기업들이다.

수평 M&A 대상 스타트업

Virtuix는 가상 게임 회사로, 게임에서 자유롭고 자연스럽게 움직이는 가상 현실 인터페이스를 판매하는 기업이다.

Network Capability 측면의 스타트업 추천맵 – 삼성전자



수직 M&A 대상 스타트업

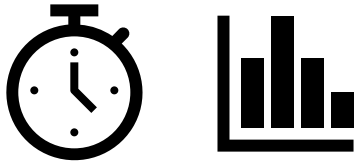
#CNXTEch는 VR/AR를 포함한 여러 분야의 애플리케이션이나 제품을 소셜 네트워크 서비스와 같은 플랫폼을 활용해 마케팅을 실시한다. 나라별 맞춤 서비스를 제공하기 때문에 글로벌 인적 네트워크를 형성하고 있다.

수평 M&A 대상 스타트업

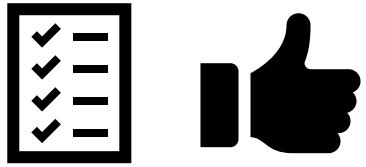
Advanced Virtual, Qumranet, NantMobile들은 각각 AR/VR 관련 운영체제, 가상환경 플랫폼에 중점을 두고 있는 기업이다.

본 연구를 통해,

1. 수많은 스타트업 중 기업의 기술 개발 방향에 부합하는 스타트업을 찾는데 많은 자원과 시간을 쏟는 기업의 노력을 덜어줄 수 있을 것으로 기대된다.



2. 기업이 추구하는 다양한 전략에 따른 후보 리스트를 제시함으로써 인수 합병시에 기업의 의사결정에 구체적인 도움이 될 것으로 생각된다.



3. 정보 불균형의 손실을 줄여 시장 참여자들 간의 교류를 활성화 시킬 수 있을 것이고, 산업 생태계에 전반에 긍정적인 요소가 될 것으로 기대된다.

Thank You

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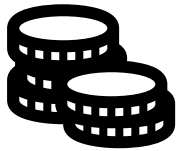
Literature Review – 유망 스타트업

✓ **스타트업이란 창업한지 얼마되지 않은 어리고 작은 회사(벤쳐/창업 회사)**(Unger et al., 2011).

- 빠른 의사결정이 가능, 시장 환경 변화에 대해 유연함(Berends et al., 2014; Crockett et al., 2013).
- 탁월한 새로운 사업기회 포착(van Burg et al., 2012).
- 파괴적 혁신의 동력(Reid et al., 2015; Tidd, 2001).
- 상업화 시장의 개척(van Praag & Versloot, 2007).

✓ **재정적**

- 수익 구조 및 안정성
- 투자자의 성격



✓ **인적**

- 창립자의 성격(리더십, 동기부여,...)
- 창립자의 교육수준
- 창립자의 이전 사업경험
- 창립팀의 명수

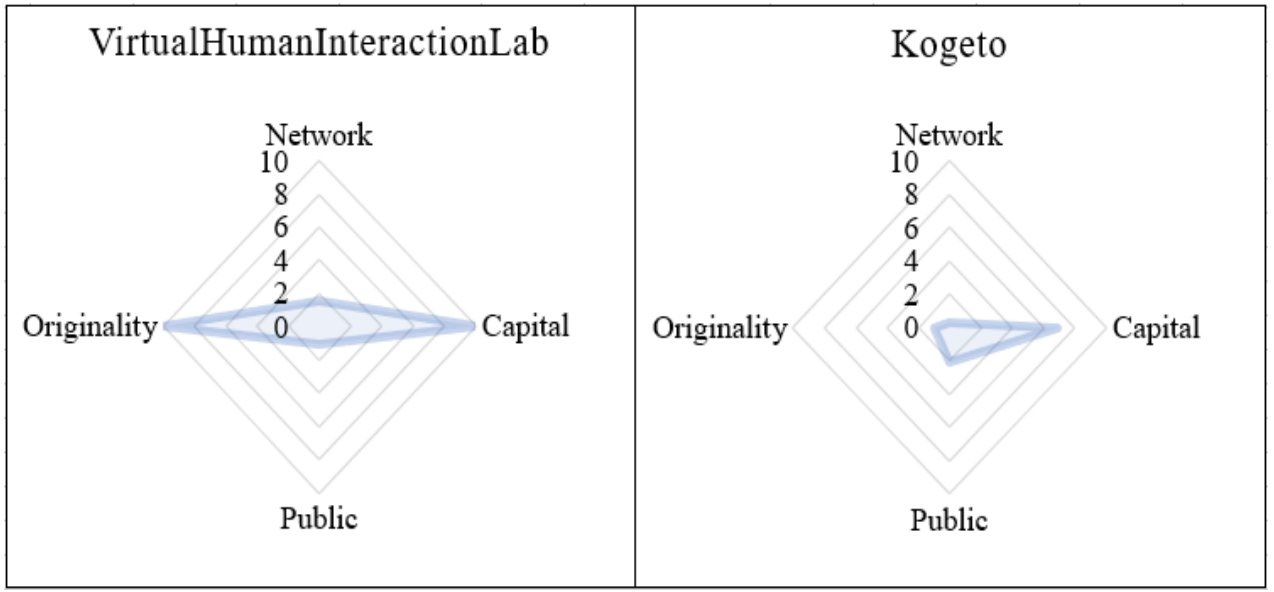
✓ **사회적**

- 시장의 특성과 잠재력
- 시장 경쟁자 수
- 외부 환경의 변화 속도

스타트업 유망성 관련 요인분석

Area	Variables	Description	Factor1	Factor2	Factor3	Factor4
Public Exposure	**언론 기사 수**	기사에 노출된 횟수	0.43	-0.12	0.07	0.07
Public Exposure	**참여 이벤트 수**	컨퍼런스 등 행사에 참여한 횟수	0.44	-0.05	-0.20	0.15
Network Capability	**투자자 수**	스타트업에 투자를 한 투자자 수	0.25	0.36	-0.07	-0.16
Network Capability	**이전 창업 경험**	창업 팀의 창업 평균 경험 횟수	-0.27	0.65	0.26	0.16
Network Capability	**창립자 수**	창업 팀의 창업자 수	0.06	0.53	-0.21	-0.08
Capital Status	**총 펀딩액***	모금한 펀딩액	0.29	-0.06	0.32	-0.16
Capital Status	**총 수익***	총 수익	-0.02	-0.04	0.56	-0.20
Capital Status	**직원 수**	스타트업 직원 수	-0.08	0.03	0.56	0.25
Technology Originality	**기술 독창성 (1/경쟁자수)**	비슷한 기술을 가진 스타트업의 수	0.06	-0.02	-0.02	0.88

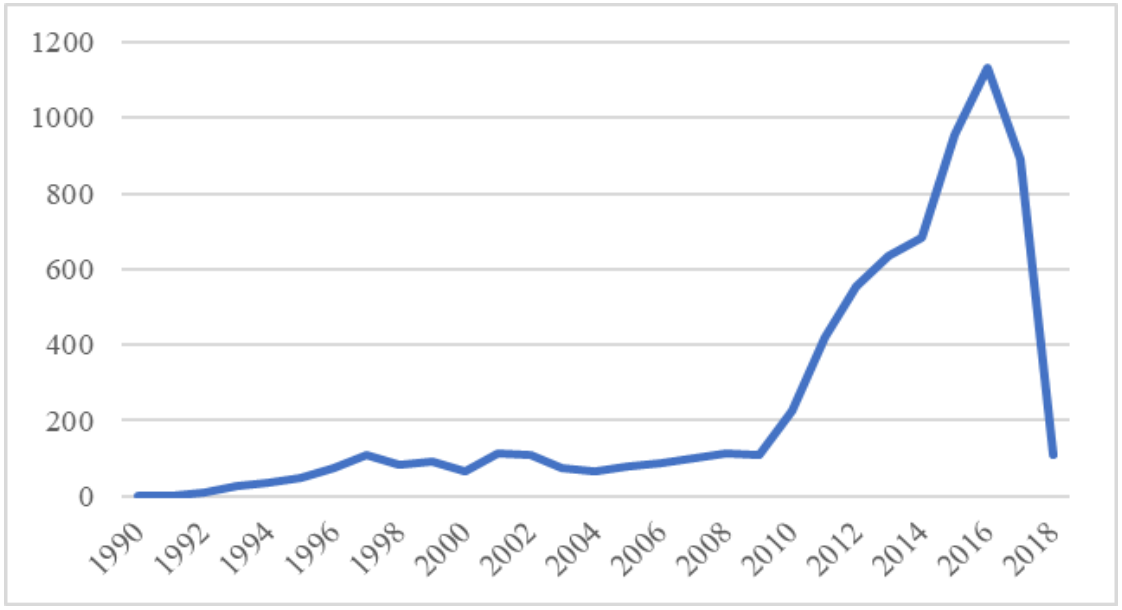
Appendix



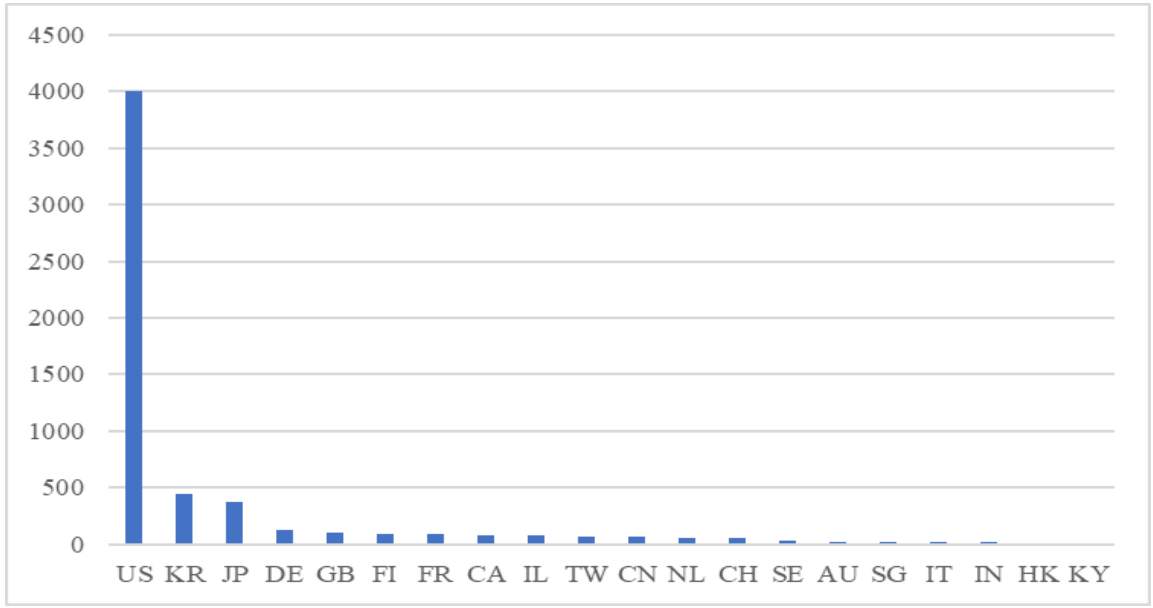
스타트업 유망성 Square 예시

각 요인별 스코어 값을 스타트업별로 계산하여 4가지 측면에서의 10점 스케일 점수를 사각형으로 나타낸 것이다. 이 맵을 통해서 스타트업이 전반적으로 얼마나 유망한지 시각적으로 알 수 있고, 더불어서 어느 방면으로 강점이 있는지 단번에 파악할 수 있다.

Appendix



VR/AR 관련 출원 특허수(1990-2018)

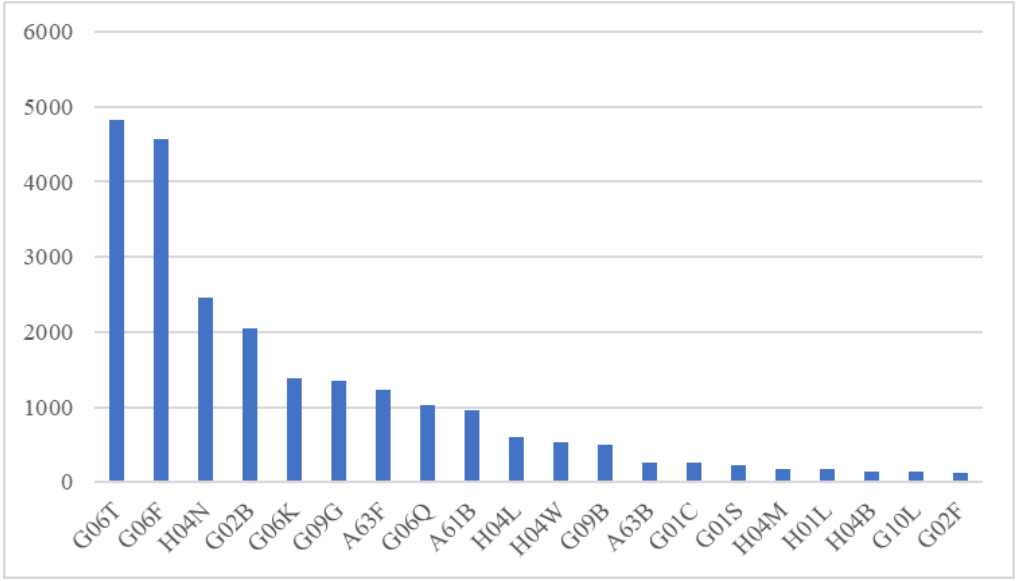


VR/AR 관련 특허 수 기준 상위권 나라

Appendix

VR/AR 관련 특허 출원 기업 상위 20

Applicant	# of Patents
MICROSOFT TECHNOLOGY LICENSING LLC	333
MAGIC LEAP INC	262
INTERNATIONAL BUSINESS MACHINES CORP	162
SAMSUNG ELECTRONICS CO LTD	158
SONY CORP	118
INTEL CORP	114
QUALCOMM INC	105
GOOGLE INC	96
DAQRI INC	92
DISNEY ENTERPRISES INC	79
MICROSOFT CORP	75
EMPIRE TECHNOLOGY DEVELOPMENT LLC	69
LG ELECTRONICS INC	68
AMAZON TECHNOLOGIES INC	66
UNIVERSAL DISPLAY CORP	60
PANTECH INC	57
ETRI	54
SIEMENS AG	54
CANON KK	53
APPLE INC	44



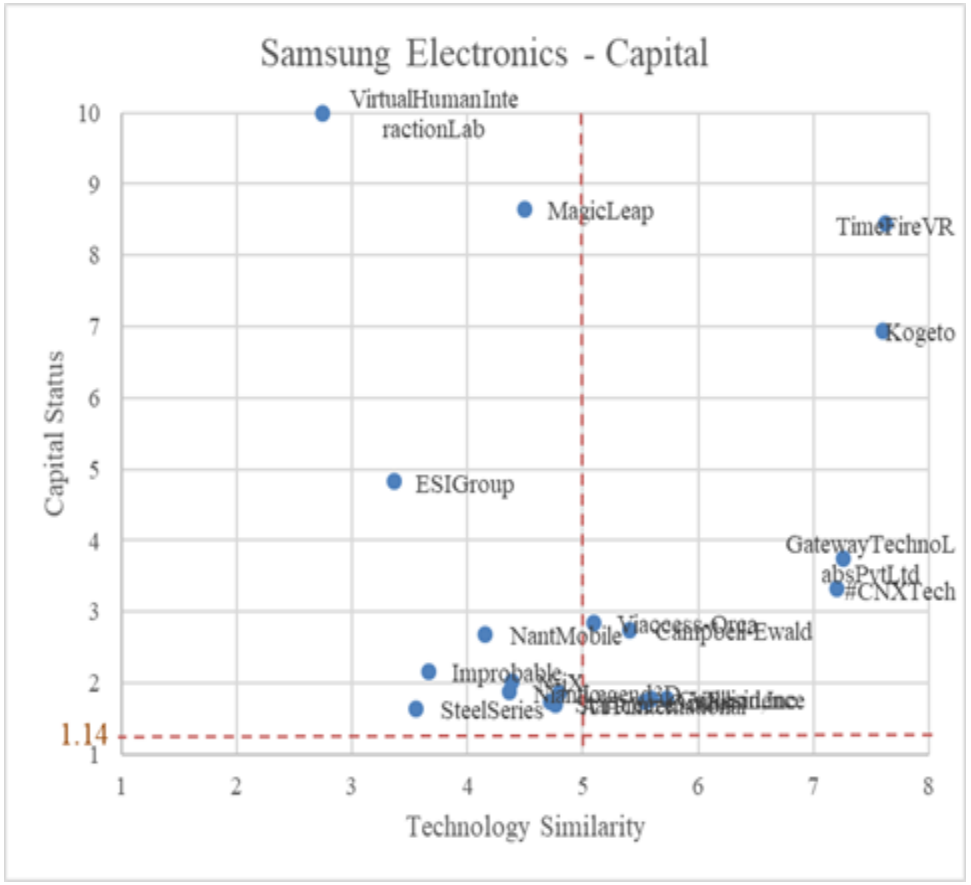
VR/AR 관련 특허 IPC 상위 20

스타트업 관련 변수 기초 통계량

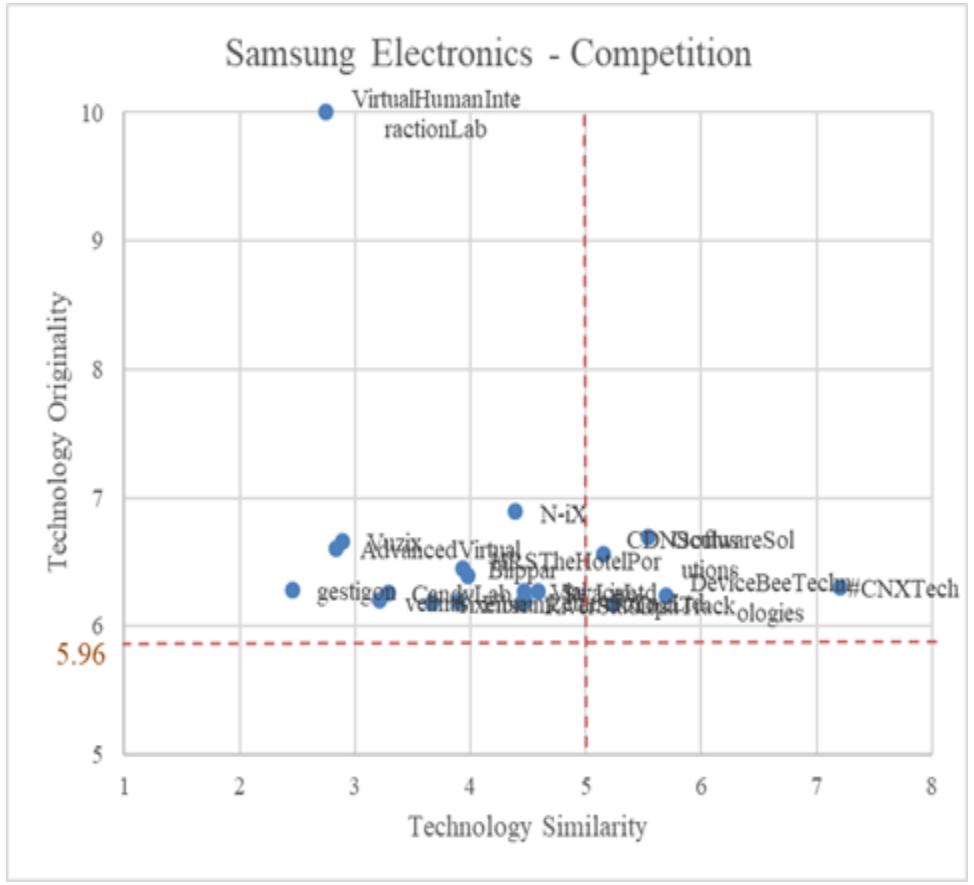
	직원 수	투자자 수	창립자 수	언론 기사 수	참여 이벤트 수
평균	30.88	1.19	1.63	9.9	0.66
최대	10,000	27	10	4,164	21
최소	0	0	1	0	0
표준편차	236.91	2.87	1.02	100.68	1.55
	총 수익*	총 펀딩액*	경쟁자수	이전 창업 경험 수	
평균	1,612,737	3,853,712	1,274.8	1.23	
최대	8.04E+08	2.35E+09	1	18	
최소	0	0	1972	1	
표준편차	22,651,679	52,361,266	660.36	0.697	

*단위: USD

Appendix



Startup Recommendation Map based on
Capital – Technology Similarity



Startup Recommendation Map based on
Competition – Technology Similarity

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