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İÇİNDEKİLER

HAVALİMANLARINDA YAPAY ZEKÂNIN GELECEĞİ İLE İLGİLİ YOLCU DENEYİMLERİNE YÖNELİK NİTEL BİR ARAŞTIRMA

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Özet

Gelişmekte olan ülkelerde yapay zekâ, yaşamın vazgeçilmez bir parçası haline gelmektedir. Yapay zekâ, bilgisayar sistemlerinin insan benzeri zekâya sahip olma yeteneğidir. Yapay zekâ, veri analizi ve makine öğrenmesi gibi teknikler kullanılarak havalimanları gibi kilit sektörlerde kullanılmaktadır. Havacılık sektörü sürekli gelişen ve yenilikçi çözümler sunan bir sektör olduğundan dolayı AI teknolojisi seyahat endüstrisinde büyük bir potansiyele sahiptir. Yapay zekâ, yolculara bilgi sağlamak, uçuş durumuyla ilgili en güncel bilgileri sağlamak, rehberlik sağlamak gibi görevlerde kullanılmaktadır. Yapay zekâ teknolojisi aynı zamanda hava trafik yönetimi, rota planlama, tehdit analizi, operasyonel verimlilik gibi birçok alanda kullanılmaktadır. Havalimanları modern toplumda önemli bir rol oynamaktadır. Yapay zekâ, yolcu deneyimini iyileştirmek için kişiselleştirilmiş öneriler sunmak üzere çalışmaktadır. Yapay zekâ, gerçek zamanlı uçuş bilgileri sağlayarak ve hizmetleri yolcuların tercihlerine göre uyarlayarak zaman tasarrufu sağlamaktadır. Yapay zekâ, havalimanı operasyonlarını ve güvenlik süreçlerini kolaylaştırabilir ve havalimanlarının çevresel hedeflerine katkıda bulunabilir. Veri toplama örnekleminde 14 kişiyle yüz yüze görüşme yapılmış olup, her görüşme ortalama 5 ila 6 dakika sürmüştür. Veriler yarı yapılandırılmış görüşmeler yoluyla toplanmıştır. Kullanılan analiz yöntemi Maxqda analiz programı ile gerçekleştirilen içerik analizidir. Sonuçlar iki ana tema ve sekiz alt temaya ayrılarak kodlama yoluyla incelenmiştir. Sonuçlar, katılımcıların yapay zekaya olan güvensizliği ile düşük teknolojik okuryazarlık arasında güçlü bir korelasyon olduğunu gösterdi ve yapay zekanın yolcu deneyimini iyileştirme potansiyelini vurgulamıştır.

Anahtar Kelimeler: Yapay zeka, havacılık, havalimanı yönetimi, yolcu deneyim.

Jel Kodu: M00, M10, M20

A QUALITATIVE RESEARCH ON PASSENGER EXPERIENCES ABOUT THE FUTURE OF ARTIFICIAL INTELLIGENCE IN AIRPORTS

Abstract

Artificial intelligence is becoming an indispensable part of life in developing countries. Artificial intelligence is the ability of computer systems to have human-like intelligence. Artificial intelligence is being used in key sectors such as airports, using techniques such as data analysis and machine learning. AI technology has great potential in the travel industry, as the aviation industry is constantly evolving and offering innovative solutions. Artificial intelligence is used in tasks such as providing information to passengers, providing the most up-to-date information about flight status, and providing guidance. Artificial intelligence technology is also used in many areas such as air traffic management, route planning, threat analysis and operational efficiency. Airports play an important role in modern society. Artificial intelligence works to provide personalized recommendations to improve the passenger experience. Artificial intelligence saves time by providing real-time flight information and adapting services according to passengers' preferences. Artificial intelligence can streamline airport operations and security processes and contribute to airports' environmental goals. Face-to-face interviews were conducted with 14 people in the data collection sample, and each interview lasted an average of 5 to 6 minutes. Data were collected through semi-structured interviews. The analysis method used is content analysis performed with the Maxqda analysis program. The results were divided into two main themes and eight sub-themes and examined through coding. The results showed a strong correlation between participants' distrust of AI and low technological literacy, highlighting the potential of AI to improve the passenger experience.

Keywords: Artificial intelligence, aviation, airport management, experience of passenger.

Jel Classification: M00, M10, M20

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1. GİRİŞ

Gelişmekte olan dünya ile yapay zekâ yaşamın vazgeçilmez bir parçası haline gelmiştir. Yapay zekâ tanımı temelinde, bilgisayar sistemlerinin insan benzeri zekâya sahip olma yeteneğini ifade eder. Yapay zekâ, makine öğrenimi ve veri analizi gibi yöntemlerle çalışır. Whitby yapay zekâyı şu şekilde tanımlamaktadır: "İnsanlarda, hayvanlarda ve makinelerde akıllı davranışın ne olduğunu inceleyen ve yapay cihazların bu davranışı nasıl sergileyebildiğini açıklamaya çalışan bilim dalıdır. (Whitby, 2005). Yapay zekâ, verileri analiz ederek desenleri tanımlayabilir, kararlar alabilir ve sorunları çözebilir. Günümüzde neredeyse her sektörde büyük rol oynayan yapay zekâ Havacılık sektöründe de önemli bir rol oynamaktadır. Havacılık gibi ekonomik güç, bilgi gücü ve askeri gücü içinde barındıran alanlara ilişkin öncelikli teknolojilerin geliştirilmesi ve uzun vadeli çalışmaların başarılmasında uygun insan gücünün yetiştirilmesi önemli bir yer tutmaktadır (Ödemiş, 2014).

Havacılık, dünyada hızla gelişen ve büyüyen bir endüstridir. Havacılık sektörü, uçaklar havalimanları, havayolları ve havacılıkla ilgili diğer faaliyetleri de kapsar. Havacılık sektörü dünya genelinde büyük bir ekonomik etkiye sahiptir ve insanların uzak mesafelere seyahat etmesini sağlamak, ticaretin gelişmesine katkıda bulunmak ve acil durumlarda hızlı yardım sağlamak gibi önemli roller üstlenir. Havacılık sektörü, teknolojik gelişmelerle birlikte sürekli olarak ilerlemekte ve yenilikçi çözümler sunmaktadır. Havacılık endüstrisi, tarih boyunca sürekli olarak yeniliklere odaklanmış ve uçuşları daha emniyetli, verimli ve erişilebilir hale getirmek için bir dizi teknolojik devrim geçirmiştir (Jiang vd., 2023). Havalimanlarındaki yapay zekâ teknolojisi, seyahat endüstrisi için büyük bir potansiyele sahiptir. Havacılık firmaları gelirlerini çoğaltmak, operasyonlarını geliştirmek ve inovasyonu teşvik etmek amacıyla dijital teknolojileri kullanmaktadır (Tutar vd., 2018).

Havalimanlarında, yapay zekâ teknolojilerini birçok alanda uygulanmaktadır. Yapay zekâ, bilgisayarlara insan zekâsını modelleyerek akıl yürütme, problem çözme, anlam çıkartma, genelleme ve öğrenme gibi yetenekleri kazandırma amacını taşımaktadır. (Yılmaz, 2021). Bu sistemler genellikle otonom çalışabilir, çevresel koşulları öğrenerek davranışlarını uyarlayabilirler (UNICEF, 2021). Yapay zekâ teknolojileri sürekli olarak gelişiyor ve yolculara bilgi sağlamak, uçuş durumu güncellemeleri sunmak ve yönlendirme yapmak gibi görevlerde de kullanılmaktadır. Son zamanlarda kabul görmüş yenilikçi dijital yaklaşımlar, yapay zekâ teknolojileri, otopilot ile sistemler, hava trafik yönetimi, rota planlama, yakıt yönetimi, tehdit analizi, eğitim, operasyonlar verimlilik, müşteri hizmetleri gibi birçok alanda kullanıldığını görmek mümkündür (Çankaya, 2020).

Havalimanları günümüzün modern toplumunda önemli bir rol oynamaktadır. Her yıl milyonlarca insanın seyahat ettiği turizm, ticaret ve ulaşım merkezleri olarak havalimanları, dünya çapında önemli varlıklardır. Havalimanlarındaki hizmetler, yolcuların seyahatlerini daha keyifli ve sorunsuz hale getirir. Havalimanları yolcuların seyahatlerini başarılı bir şekilde gerçekleştirebilmeleri için birçok hizmet sunar. Ancak havalimanlarının karmaşık ve yoğun olması yolcular için bazen zorluklar oluşturabilir. Havalimanlarında yolcuların yaşadığı en büyük sorunlardan biri zaman kaybı, uzun kuyruklar ve karmaşık yönlendirme sistemleridir. Havalimanlarında yaptığımız manuel işlemler zaman kaybetmemize neden olmaktadır.

Kapasitenin yetmemesi, gecikmelerin yaşanmasına, buna karşın güvenlik tedbirleri attırıldığı halde bu tedbir uygulamalarının artması ve çok fazla tedbir aşamasının olması ile vakit kaybına sebebiyet vermektedir (Chang-Geun Oh, 2017). Bu durum yolcu deneyimini olumsuz yönde etkilemektedir. Yapay zekânın büyük rol oynadığı yer burasıdır. Yolcuların deneyimini daha hızlı ve sorunsuz hale getirmek için yapay zekâ devreye girer. Yolcuya sunacağı faydalar sayesinde zamandan tasarruf sağlayacak yöntemler sunar. Yapay zekâ, yolcuların tercihlerine göre kişiselleştirilmiş öneriler sunar. Yapay zekâ, uçuş durumuyla ilgili gerçek zamanlı güncellemeler hakkında bilgileri yolcuya bildirir. Yani yapay zekâ sayesinde uçuş öncesi ve uçuş sürecindeki deneyim yolcular için daha kolay hale gelebilir. Yapay zekâ, bu sayede havaalanı operasyonlarında devrim yaratabilir ve yolcu deneyimlerini iyileştirebilir. Bunun yanın sıra yapay zekâ, güvenlik süreçlerini daha etkin hale getirmek ve olası tehditleri tespit etmek için de kullanılabilir. Bu nedenle yapay zekâ teknolojisinin havalimanı operasyonlarında ve havalimanı yönetiminde kullanılması büyük önem taşımaktadır. Ayrıca, yapay zekâ sistemleri, havalimanlarının karbon ayak izini azaltmak gibi çevresel hedeflerine de katkıda bulunabilir.

2. YAPAY ZEKÂ

Yapay zekâ, çoğunlukla akıllı bilgisayar programlarının yapıldığı bilim ve mühendislik çalışmalarının genelinin adıdır (Rajaraman, 2014). Ayrıca karar verme, problem çözme ve öğrenme gibi insan özellikleri taşıyan, diğer bir değişle belleği olan ve insanların yapabildiklerini bilgisayarlara yaptırabildikleri makinelerdir (Haugeland, 1985). Yaşamımızda etki ve kapsam alanını giderek arttıran yapay zekâ, gündelik hayatımızda başrol etkisi görmektedir. Yapay zekâlar birçok ürünün önemli bir bileşeni haline geldiğinden, insan hayatının ayrılmaz bir parçası olma yolunda ilerlemektedir (Chen vd., 2016: 3). Uluslararası Arşiv Konseyi (International Council on Archives) tarafından Nisan 2019'da düzenlenen Norveç 3. Arşiv Konferansı'nda yapay zekâ "bir makinenin/sistemin herhangi bir faaliyet sırasında bir sonucu tahmin etmek için bilgi aldığı (yapılandırılmış ve yapılandırılmamış) her şey" olarak tanımlanmıştır (Pratical Guide of Organization, 2018). Yapay zekâ, makinelerin insan zekâsının belirli yönlerini simüle etme yetenekleri anlamına gelir. Bu, özellikle makine öğrenmesi ve derin öğrenme kavramlarında belirgin hale gelmiştir. Makine öğrenmesi, algoritmaların ve istatistiksel modellerin verilerden bağımsızca öğrenme ve tahminler yapma yetenekleri üzerine kurulmuştur. Derin öğrenme ise, makine öğrenmesinin bir alt kümesi olarak kabul edilir ve esas olarak yapay sinir ağlarının karmaşık veri kümelerinden öğrenme yeteneklerine odaklanır. Derin öğrenme algoritmaları, katmanlı sinir ağları (yüzlerce veya hatta binlerce katmanlı olabilen) kullanır ve bu ağlar milyonlarca veya hatta milyarlarca parametre içerebilir. Bu, bu tür bir yapay zekânın "kara kutu" olarak görülmesine yol açar. Yani, bu sistemler bir girdi aldığında ve bir çıktı verdiğinde, aradaki süreç genellikle insan tarafından anlaşılmaz. Açıklanabilir yapay zekâ, bu durumu çözme girişimidir. Açıklanabilir yapay zekâ, algoritmaların karar verme süreçlerinin daha açık ve anlaşılır olmasını sağlar (Gunning vd., 2019).

Algoritmalar ve veri modelleri kullanarak desenleri tanıma, tahmin yapma ve otomatik karar verme gibi işlemleri gerçekleştiren yapay zekâ veri analizi, öğrenme ve problem çözme gibi yeteneklerle karmaşık görevleri yerine

getirebilen bir sistemdir. Birçok alanda kullanılabilecek potansiyele sahip olan yapay zekâ insanların hayatını daha kolay ve verimli hale getirebilmeye olanak sağlar. Yapay zekâ, öneri sistemleri, otomatik araçlar ve otonom robotlar gibi alanlarda büyük rol oynarken otomatik dil çevirisi, doğal dil işleme ve konuşma tanımı gibi alanlarda da kullanılır (Crompton & Burke, 2023).

Yapay zekâ; yapay sinir ağları, uzman sistemler, bulanık mantık ve genetik algoritma olmak üzere çeşitli bileşenlerden oluşmaktadır (Pirim, 2006). Yapay sinir ağları, "insan beyninden esinlenilerek geliştirilmiş, ağırlıklı bağıntılar aracılığıyla birbirine bağlanan ve her biri kendi bağına sahip işlem elemanlarından oluşan paralel ve dağıtılmış bilgi işleme yapılarıdır. Bir başka deyişle, biyolojik sinir ağlarını taklit eden bilgisayar programları" (Ardıç, 2014) olarak düşünülebilir. Uzman sistemler, problem belirleyen, analitik çalışan, öğrenilmiş bilgilerden faydalanan ve deneyimlerden çıkarım yapabilen yazılımlardır. Kısaca "belirli bir uzmanlık alanındaki bilgileri zamanla kendisine geliştirebilen yazılımlardır" (Çoban, 2018). Bulanık mantık, klasik gruplandırma/kümeleme mantığından ziyade bir gruba ait elemanların tamamen o grubun özelliklerini yansıtmadığını ifade etmektedir. "Doğru, yanlış yerine biraz doğru biraz yanlış şeklinde açılımlar sergiler" (Pirim, 2006). Son olarak genetik algoritma, Nabiyev'e göre (2016) "en iyinin korunumu ve doğal seçilim ilkesinin benzetim yoluyla bilgisayarlara uygulanması ile elde edilen bir arama yöntemidir".

Havalimanları, milyonlarca insanın seyahat ettiği, ticaretin geliştiği, acil yardımların hızlı bir şekilde sağlandığı modern toplumun en önemli ulaşım merkezleri arasında yer almaktadır. Ancak havalimanlarının karmaşıklığı ve yoğunluğu sorunlara neden olabilmektedir. Uzun kuyruklar, boşa harcanan zaman ve karmaşık yönlendirme sistemleri gibi faktörler yolcu deneyimini olumsuz yönde etkileyebilmektedir. Yapay zekâ (AI), bilgisayar sistemlerinin insan benzeri zekâ yeteneklerini taklit eden çeşitli teknolojileri içermektedir (Hon, 2021). Yapay zekânın havalimanlarında kullanımı, yolcu deneyimini iyileştirme, operasyonel verimliliği artırma ve güvenlik süreçlerini optimize etme konusunda büyük bir potansiyele sahiptir.

3. HAVALİMANLARINDA YAPAY ZEKÂNIN KULLANIM ALANLARI

Havalimanlarında yapay zekâ kullanımına ilişkin birçok alan bulunmaktadır. Örneğin, seyahat sürecini daha sorunsuz hale getirmek için yolculara yapay zekâ tabanlı kişiselleştirilmiş öneriler sunulabilir. Yolcu tercihlerine dayalı bu öneriler seyahat planlaması, konaklama, yerel etkinlikler ve daha pek çok konuda yardımcı olabilmektedir. Ayrıca yapay zekâ, gerçek zamanlı uçuş durumu güncellemeleri ve talimatları sağlayarak yolcuları yolculukları boyunca bilgilendirmeye ve yönlendirmeye yardımcı olabilmektedir (Dou, 2020). Yapay zekânın kullanılması güvenlik açısından da çok önemlidir. Yüz tanıma sistemleri, davranış analiz yazılımı ve biyometrik teknoloji gibi yapay zekâ uygulamaları, havalimanı güvenlik standartlarını iyileştirecektir. Bu sistemler olası tehditleri daha hızlı ve doğru bir şekilde tespit ederek güvenlik personeline uyarı gönderebilmektedir.

Havacılık sektöründe otomasyon ve yapay zekânın benimsenmesi hızlandıkça akıllı teknoloji, olası krizler

sırasında havayollarının ve havalimanlarının desteklenmesinde önemli bir rol oynayacaktır. Örneğin, COVID-19 gibi bir kriz sırasında havalimanları birçok standardı kolayca otomatikleştirebilecek ve verimliliği artıracak ve insan temasını en aza indirecek yeni özellikler geliştirilecektir (Seçkiner vd., 2021).

Yapay zekâ kullanımı operasyonel verimlilik açısından da önemli faydalar sağlamaktadır. Otomatik yönlendirme sistemleri, gerçek zamanlı veri analiz araçları ve tahmine dayalı bakım teknikleri gibi yapay zekâ uygulamaları, havalimanı operasyonlarını optimize edebilir ve kaynakların daha verimli kullanılmasını sağlayabilmektedir. Bu, havalimanlarının daha verimli ve esnek olmasına olanak tanır. Son olarak, yapay zekânın havalimanlarında kullanımı çevresel sürdürülebilirlik açısından önemlidir. Yapay zekâ tabanlı sistemler enerji tüketimini optimize etmeye, atıkları azaltmaya ve karbon emisyonlarını azaltmaya yardımcı olmaktadır. Bu, havalimanının çevresel etkisini azaltır ve daha sürdürülebilir bir geleceğe katkıda bulunmaktadır. Artan teknolojiyle havaalanlarını duygu ve tutku yoğunluklarının yaşandığı küresel duraklar (Urry vd., 2016: 13) olmaktan çıkararak, yolcular ile çeşitli teknolojiler arasında interaktif süreçleri barındıran yaşam merkezlerine dönüşmüştür. Yeni kimliklerine dönüşen, dönüşebilen havaalanları ise hizmet teknolojisinde yarattıkları farklılık ve iyileştirmelerle yolcularına çok daha fazla iyi deneyim sunmakta, bu sayede seyahatçinin aldığı keyif, duyduğu güven ve memnuniyet artmaktadır (Bogicevic vd., 2017).

Tüm bu faydalar göz önüne alındığında havalimanlarında yapay zekâ kullanımı giderek popüler hale gelmektedir. Ancak bu teknolojinin etkili bir şekilde uygulanması, sıkı veri güvenliği önlemlerini ve etik konuların dikkate alınmasını gerektirir. Ayrıca insan etkileşimi ve takibi gerektiren durumlarda yapay zekâ teknolojisinin tamamlayıcı bir araç olarak kullanılması gerekmektedir. Bu nedenle havalimanlarında yapay zekânın kullanılması yolcu deneyimini iyileştirmek, operasyonel verimliliği artırmak, güvenliği optimize etmek ve çevresel sürdürülebilirliği desteklemek için önemli bir araçtır (Soori, 2023). Bu teknolojinin gelecekteki uygulamaları havalimanlarını daha akıllı, daha güvenli ve daha sürdürülebilir hale getirecektir.

4. YÖNTEM

4.1. Verilerin Toplanması

Bu çalışmada havalimanlarında yapay zekâ kullanımının yolcu deneyimleri ve görüşleri üzerindeki etkisini anlamak için nitel araştırma yöntemleri uygulanmıştır. Tercih edilen araştırma tasarımı, tanımlayıcı bir araştırma türü aracılığıyla havalimanlarında yapay zekâ kullanımına ilişkin yolcuların deneyimlerinin genel resmini yansıtan nitel bir araştırma yöntemidir. (Armstrong, 1970). Veri toplama sürecinde yolcularla yüz yüze veya çevrimiçi olarak yarı yapılandırılmış görüşme tekniği kullanılarak bireysel görüşmeler yapılmıştır. Nitel analiz sürecinde, katılımcıların profilini dikkate alarak; özellikle sık uçan yolcular ile görüşmeler gerçekleştirilmiştir. Havalimanlarında yapay zekâ kullanımının havalimanı deneyimi üzerindeki etkisini daha iyi anlamak ve bu konuda iyi bir fikir edinmek için bu seçim yapılmıştır Sık uçanların ve yoğun iş hayatlarına sahip olanların havalimanlarında yapay zekâ teknolojisiyle daha yakın ve daha çeşitli etkileşimlerde bulunması beklenilmektedir. Dolayısıyla katılımcıların bu profillerle ilgili deneyimlerinden elde edilen veriler, analiz

sürecinde önemli bir bakış açısı sağlamalıdır. Örneklem seçiminde farklı demografik özelliklere sahip katılımcıların temsil edilmesini sağlamak amacıyla çeşitli kriterler dikkate alınmış ve yeterli örneklem büyüklüğüne ulaşmak için katılımcı çeşitliliğine dikkat edilmiştir. 14 kişi ile yüz yüze şekilde sorular sorulmuş ve ortalama 5-6 dakika içinde cevaplandırılmıştır. Veri analizi kapsamında görüşmeler kayıt altına alınarak yazıya aktarılmıştır ve nitel içerik analizi yöntemleri kullanılarak temalar ve örüntüler belirlenmiştir. Araştırma süreci katılımcıların mahremiyetini koruyacak şekilde rahat bir ortamda özenle yürütülmüştür. Bu araştırma metodolojisi, havalimanlarında yapay zekâ kullanımına ilişkin yolcu görüşlerinin anlaşılmasına yönelik kapsamlı ve sistematik bir yaklaşım sunarak, yapay zekâ uygulamalarının havalimanı deneyimlerini nasıl etkilediğinin belirlenmesine yönelik önemli bilgiler sağlamıştır. Katılımcıların dahil edilme kriterlerine geçilmeden önce İstanbul Nişantaşı Üniversitesi Rektörlüğü Etik Kurulundan 20.12. 2023 tarih ve 2023/44 sayılı karar ile etik kurul raporu alınmıştır. İlgili kurul raporunun alınmasının ardından 10.01.2024- 10.02.2024 tarihleri arasında katılımcılardan rapor toplanılmıştır.

Tablo 1. Katılımcılar

Katılımcılar	**Cinsiyet**	**Yaş**	**Eğitim Durumu**	**Ayda Kaç Uçuş Gerçekleştirdiği**
K1	Erkek	35	Önlisans	8-10
K2	Kadın	32	Lisans	15-18
K3	Erkek	25	Lisans	10-12
K4	Erkek	40	Lisans	5-7
K5	Erkek	28	Önlisans	12-14
K6	Erkek	45	Lisans	3-4
K7	Erkek	30	Lisans	8-10
K8	Kadın	38	Lisans	6-7
K9	Kadın	29	Lisans	9-11
K10	Kadın	34	Lisans	10-12
K11	Kadın	31	Lisans	8-10
K12	Kadın	27	Lisans	5-7
K13	Kadın	36	Lisans	10-12
K14	Erkek	33	Önlisans	4-5

4.2. Verilerin Analizi

Görüşmelerin sonuçları içerik analizi yöntemi kullanılarak incelenmiştir. Öncelikle ses kayıtları yazılı metinlere dönüştürülerek toplam 15 sayfalık metin elde edilmiştir. Her yazar bu metni bağımsız ve ayrıntılı olarak değerlendirmiştir. Ana hedefimiz, yolcuların havaalanlarında yapay zekâdan nasıl faydalandığını ve bu sistemlerin gelecekte nasıl görüneceğine dair vizyonlarını anlamaktır. Araştırma süreci sonunda konuyla ilgili olmayan gereksiz ifadeler çıkarılmıştır. Çalışma Maxqda analiz programında analizleri yapılmıştır.

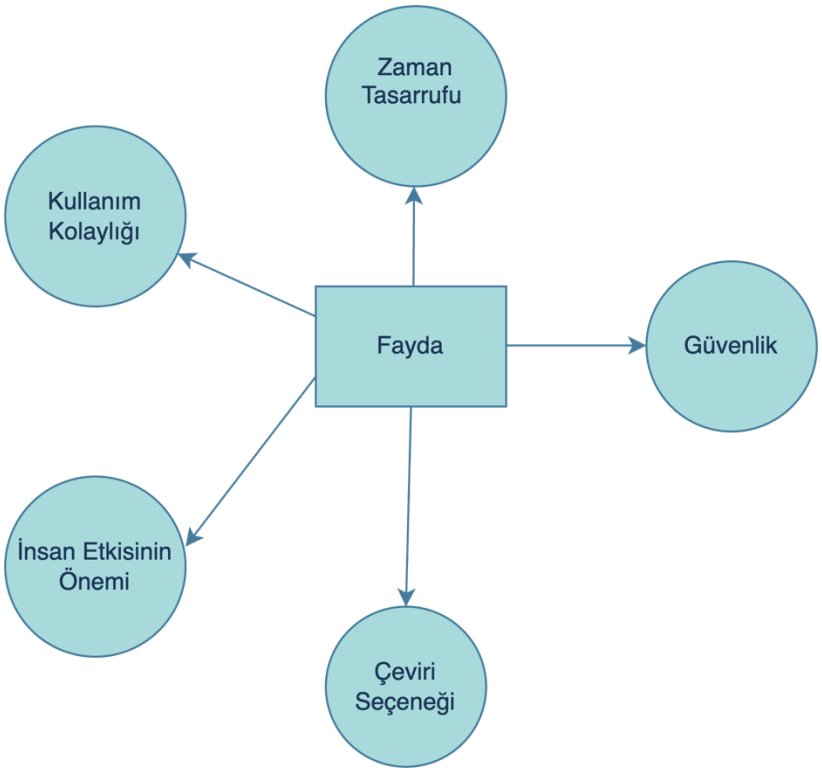
Yazılı ve sözlü materyali sistematik olarak analiz etme ve insanların ne söylediğini ve yazdıklarını açık yönergelere göre kodlayarak belirleme sürecidir. İçerik analizi, sözlü ve yazılı verilerin belirli bir problem veya amaç doğrultusunda sınıflandırılması, özetlenmesi, o verilerdeki belirli değişkenlerin veya kavramların ölçülmesi ve bu verilerin belirli bir anlam için taranması ve kategorize edilmesi sürecidir. Kategoriler öncelikle

içerik analizi yöntemi kullanılarak belirlenmiştir. Bu çalışma için yedi soru tasarlanmıştır. Farklı alanlara odaklanan sorularla yolcuların havalimanlarında yapay zekâ kullanımına ilişkin deneyimleri sorulmuştur. Öncelikle havalimanlarında yapay zekâdan nasıl faydalanabileceğinize dair sorular; Bunu havayolu endüstrisinde yapay zekâ kullanımının yolcular için faydalarını araştıran sorular takip etti. Daha sonra yapay zekânın yolcuların işini kolaylaştırıp kolaylaştırmadığını, yapay zekânın uçuş öncesi ve uçuş sırasında ne gibi tehlikeler yarattığını düşündüler. Ayrıca yapay zekânın gelecekte hava trafik kontrol merkezlerinde kullanımını sorgulayan soru, yapay zekâ destekli havalimanı sistemlerinin dil ve kültürel engelleri aşmaya nasıl yardımcı olduğu, havalimanlarında hangi faktörlerin yapay zekâ kullanımını gerektirdiği şeklinde yedi adet soru yöneltildi. Bu çeşitli sorular, havalimanlarında yapay zekâ kullanılırken yolcu deneyimlerini ve beklentilerini kapsamlı bir şekilde anlamak için tasarlanmıştır ve görüşmeler bu yedi soru temel alınarak ayrı ayrı gözden geçirilmiştir. Daha sonra çalışmaya dayanarak bir sonuç çıkarılmıştır. Yolcuların deneyimlerini yansıtan kelimeler kullanılarak kodlar ve kategoriler oluşturulmuştur. Bu adımda, öncelikle görüşme verileri, içerik analizi kapsamında verilerin çıkarılması ve anlamlı parçalara isimlendirilmesi süreci olarak tanımlanan kodlama yoluyla kavramsallaştırılmıştır. Kodlanan tüm veriler yeniden okunarak ve veriler kodlanırken ilk olarak kodun özünün ne olduğu bulunmaya çalışılmıştır (Glesne, 2014, Berg & Lune, 2017). Bu kodlar arasındaki ilişkiler incelenerek ana temalar ve alt temalar belirlenmiştir. Bu sayede yolcuların havalimanlarında yapay zekâ kullanımına ve geleceğe ilişkin düşüncelerini anlamak amacıyla tematik bağlantılar anlatılmış ve yorumlanmıştır.

5. BULGULAR

Görüşmeler sonucunda elde edilen veriler temalandırılmış, iki ana tema analiz edilmiş ve toplamda 8 alt temaya ulaşılmıştır.

Şekil 1. Yapay Zekâya Duyulan Güvensizlik Teması ve Alt Temaları



Şekil 2. Yapay Zekâ Kullanımın Faydası Teması ve Alt Temaları

5.1. Yapay Zekâya Duyulan Güvensizlik Teması ve Alt Temalar

Tablo 2. Yapay Zekâya Duyulan Güvensizlik Teması ve Alt Temaları Arasındaki Kod İstatistikleri

Kod Sistemi	**Teknolojik Okur Yazarlığın Zayıf Olması**	**Yapay Zekânın Yolcu Hizmetlerindeki Kullanımı**	**İşi Kaybetme Korkusu**	**TOPLAM**
Yapay Zekâya Duyulan Güvensizlik	5	7	3	15
İşi Kaybetme Korkusu	3	2	0	5
Yapay Zekânın Yolcu Hizmetlerindeki Kullanımı	4	0	2	6
Teknolojik Okur Yazarlığın Zayıf Olması	0	4	3	7
TOPLAM	12	13	8	33

Katılımcıların yapay zekâ, teknik bilgi eksikliği, işini kaybetme korkusu gibi konulara ilişkin algılarını anlamak için tabloda bir kodlama sistemi kullanılmıştır. Bu kodlama sistemi bu temalar arasındaki ilişkileri keşfetmeye

yönelik bir araç olarak kullanılmıştır. Tablo 2' de gösterildiği üzere yapay zekâya duyulan güvensizlik ile katılımcıların teknik bilgilerinin düşük olması arasında bir ilişki görülmektedir. Teknolojik açıdan daha az bilgili olan kişilerin, karmaşık algoritmalara ve otomatik sistemlere dayanması nedeniyle yapay zekâya karşı daha şüpheci olabileceği ileri sürülebilir. Örneğin teknoloji konusunda yeterli bilgiye sahip olmayan kişiler, yapay zekânın nasıl karar verdiğini anlamakta zorluk çekebilir ve bu da güvensizlik duygusuna yol açabilir. Yolcu hizmetlerinde yapay zekâ kullanımı ile iş kaybı korkusu arasında da bir ilişki olduğu gözlemlenmektedir. Örneğin katılımcılar, havalimanlarında yapay zekâ tarafından gerçekleştirilen işlerin insan işçilerin yerini alacağından ve bunun da daha büyük iş kaybı korkusuna yol açacağından endişe duyabilmektedir. Düşük okuryazarlık ile kişinin işini kaybetme korkusu arasında güçlü bir ilişki tablodan çıkartılabilmektedir. Örneğin teknoloji alanında nasıl çalışılacağını bilmeyen kişiler iş yerinde teknolojik değişimlere uyum sağlayamayacaklarına inandıkları için korkabilirler. Bu bulgular, yapay zekâ teknolojilerinin kullanımının artmasıyla birlikte yeni teknolojilerin iş dünyasındaki etkisinin, kaygı ve işini kaybetme korkusu gibi bireysel kaygıları artırabildiğini göstermektedir.

5.2. Yapay Zekâ Kullanımın Faydası Teması ve Alt Temalar

Tablo 3. Yapay Zekâya Ait Temalar ve Alt Temalar

Kod Sistemi	Güvenlik	Zaman Tasarrufu	Kullanım kolaylığı	Çeviri Seçeneği	İnsan Etkisinin Önemi	TOPLAM
Fayda	2	6	8	6	6	28
Güvenlik	0	3	4	4	2	13
Zaman Tasarrufu	3	0	7	7	6	23
Kullanım kolaylığı	4	7	0	9	8	28
Çeviri Seçeneği	4	7	9	0	7	27
İnsan Etkisinin Önemi	2	6	8	7	0	23
TOPLAM	15	29	36	33	29	142

Tablo 3'e bakıldığı zaman "Fayda" ile "Zaman Tasarrufu" ve "Kullanım Kolaylığı" kodlamaları arasında yakın bir ilişki vardır. Bu da çoğu katılımcının yapay zekâ sayesinde zamandan tasarruf ve kullanım kolaylığı beklediğini göstermektedir. Yapay zekânın havalimanlarında kullanılmasına yönelik beklentiler zaman tasarrufu ve kullanım kolaylığına odaklanmıştır.

"Güvenlik" kodu ile "İnsan Etkisinin Önemi " kodu arasında güçlü bir bağlantı vardır. Bu, katılımcıların yapay zekâ uygulamalarında güvenlik standartlarına saygı gösterme ve insan etkisine karşı koruma sağlama konusunda endişe duyduklarını göstermektedir. Yapay zekâ uygulamalarının güvenilirliği ve insan faktörlerinin dikkate alınması, yapay zekâ teknolojisinin havalimanlarında kabul edilmesi için esastır.

Öte yandan, "Çeviri Seçenekleri" kodları ile "Zaman Tasarrufu" ve "Kullanım Kolaylığı" kodları arasında açık bir bağlantı vardır. Bu durum katılımcıların hızlı ve kolay çeviri seçeneklerine ilgi duyduğunu göstermektedir. Dil engellerinin kaldırılması uluslararası seyahat edenler için önemlidir ve yapay zekâ destekli çeviri seçeneklerinin büyük avantaj sağlayabileceği yer burasıdır.

5.3. Kelime Bulutu

Şekil 3. Kelime Bulutu

Kelime bulutu ile katılımcıların yapay zekâ hakkındaki düşüncelerini, beklentilerini ve endişelerini yansıtmak amaçlanmaktadır. Örneğin, "zamandan tasarruf", "güvenlik", "kullanım kolaylığı" ve "çeviri seçeneği" gibi kelimeler, katılımcıların yapay zekâdan beklediği yararları ve öncelikleri tanımlayabilir. Benzer şekilde "güvenlik" ve "insan etkisinin önemi" gibi kelimeler de katılımcıların endişelerini ve düşüncelerini ortaya çıkarabilmektedir. Bu kelime bulutu, yapay zekâyla havacılığın geleceğine kapsamlı bir genel bakış sunmaktadır. Böylece katılımcılar için hangi konuların anlamlı olduğunu ve hangi konuların en çok ilgi çektiğini görülebilmektedir.

6. SONUÇ

Havacılıkta yapay zekânın geleceğine dair kapsamlı bir çalışma sonucunda öncelikle katılımcıların yapay zekâya olan güvensizliği ile teknolojik okur yazarlığın düşük olması arasında güçlü bir ilişki bulunmuştur. Bu eğilim, teknolojiye güvenmeyen veya teknolojik yapılara daha az aşina olan kişilerin, insanların anlama becerisine ilişkin algılarının daha yüksek olduğunu göstermektedir. Benzer şekilde düşük teknik bilgi ile işini kaybetme korkusu arasında da güçlü bir ilişki bulunmuştur. Bu durum teknolojiye uyum sağlamakta zorlanan insanların gelecekte işlerini kaybetme endişesi taşıdığını göstermektedir. Aynı zamanda katılımcıların çoğunluğunun

yapay zekâ sayesinde zamandan tasarruf ve kullanım kolaylığı bekledikleri de ortaya çıkmıştır. Bu sonuçlar, akıllı havaalanı operasyonlarının daha hızlı ve daha verimli hale geleceğine dair umudu göstermektedir.

Güvenlik ve insan etkisinin önemi gibi faktörler de vurgulanmış ve katılımcıların güvenlik ve insan çıkarlarının korunmasına ilişkin kaygıları, yapay zekânın havalimanlarında daha fazla kabul görmesi için ele alınması gereken temel konulardan bazılarıdır. Bu bulgular, havaalanlarında yapay zekânın geleceğini şekillendiren eğilimleri anlamamıza yardımcı olacaktır. Yapay zekâ uygulamalarını havalimanlarına başarılı bir şekilde entegre etmek için zaman tasarrufu, kullanım kolaylığı, güvenlik ve insan etkisinin önemi gibi faktörleri dengelemek önemlidir. Bu bağlamda akıllı teknolojilerin etkin ve sürdürülebilir entegrasyonu için paydaşlar arasındaki iş birliği ve koordinasyon esastır.

Yapay zekaya duyulan güvensizliğin temel nedenlerinden biri bu teknolojiye ilişkin bilgi eksikliğidir. Havaalanı personeli, yolcular ve diğer paydaşlar için düzenli eğitim ve bilgilendirme programları oluşturulmalıdır. Bu programlar, yapay zekâ teknolojilerinin özelliklerini, güvenlik protokollerini ve potansiyel faydalarını açıklayarak teknoloji okuryazarlığını geliştirmeyi amaçlamalıdır. İş güvenliğini sağlayan politikalar oluşturun: İş güvenliğini sağlayan politikalar, teknolojiye uyum sağlayamama korkusu nedeniyle işini kaybetmekten korkan çalışanların kaygılarını gidermek amacıyla oluşturulmaktadır. Özellikle yapay zekâ ve otomasyonun iş dünyasında getirdiği değişimler dikkate alınarak çalışanların mesleki gelişimlerini desteklemek amacıyla yeniden eğitim programları ve kariyere giriş destekleri sağlanmalıdır. Kullanıcı dostu yapay zekâ uygulamalarının tasarlanması: Havalimanı operasyonlarında yapay zeka uygulamalarının kullanıcı dostu ve zaman tasarrufu sağlaması beklenmektedir. Bu nedenle kullanıcı dostu ve erişilebilir yapay zekâ çözümlerinin geliştirilmesine ihtiyaç duyulmaktadır.

Özellikle sezgisel kullanıcı arayüzleri ve basit kullanım kılavuzları, yolcuların ve personelin bu sistemleri kullanırken kendilerini rahat hissetmelerine yardımcı olacak şekilde tasarlanmalıdır. Güvenlik ve insan etkisine odaklanma konusunda yapay zekanın havaalanı güvenliği üzerindeki etkisine ilişkin endişeler dikkate alınmalıdır. Bu bağlamda yapay zekâ uygulamalarının güvenlik protokollerine nasıl entegre edileceği ve bu teknolojilerin insan etkisini nasıl azaltacağı konusunda detaylı planlamaya ihtiyaç var. Güvenlik standartlarının yanı sıra insan hakları ve etik ilkelerin de dikkate alınması gerekir.

Yapay zekâ teknolojisinin bütünleştirilmesi süreci, kullanıcı geri bildirimlerine dayalı bir iyileştirme süreci oluşturulmasını gerektirir. Havalimanı çalışanları, yolcular ve diğer paydaşlardan düzenli olarak geri bildirimler toplanmalı ve yapay zekâ sistemi bu geri bildirimlere göre sürekli güncellenmelidir. İş birliği ve Koordinasyonun Güçlendirilmesi ile Akıllı teknolojilerin etkili ve sürdürülebilir entegrasyonu, havalimanı operatörleri, teknoloji sağlayıcıları, devlet kurumları ve diğer paydaşlar arasında güçlü bir iş birliği ve koordinasyon gerektirir. Yapay zekanın havalimanı operasyonları üzerindeki sosyal etkisinin değerlendirilmesi için düzenli analizler yapılmalıdır. Bu analizler, yapay zekâ teknolojisinin yolcu deneyimi, çalışan memnuniyeti ve sosyal kabul üzerindeki etkisini araştırarak ihtiyaç duyulan iyileştirmelerin sağlanmasını amaçlamaktadır. Yapay zekayı

bütünleştirirken farklı toplumsal grup ve bireylerin ihtiyaçlarını karşılayacak bütünleştirici bir yaklaşım benimsenmelidir. Özellikle engelli veya farklı dillerde hizmet almak isteyen yolcular için özel çözümlerin geliştirilmesi gerekmektedir.

Yukarıdaki öneriler, yapay zeka teknolojilerinin havalimanlarına etkin ve sürdürülebilir entegrasyonunu desteklemeyi amaçlamaktadır. Bu öneriler sadece teknolojik gelişmeyi değil aynı zamanda insan faktörlerini ve sosyal kabulü de dikkate alan kapsamlı bir yaklaşım sunmaktadır. Havaalanı operasyonlarını daha güvenli, daha verimli ve kullanımı daha kolay hale getirmek, tüm paydaşların birlikte çalışmasını ve üretilen geri bildirimleri sürekli olarak değerlendirmesini gerektirir.

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BIBLIOMETRIC ANALYSIS OF CORPORATE VENTURE CAPITAL IN MANAGEMENT AND BUSINESS LITERATURE

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Abstract

Corporate Venture Capital (CVC) has sparked significant interest in the fields of management and business studies. This study utilizes bibliometric analysis to examine CVC from 1983 to 2024 within the management and business category, drawing from 281 data points from the Web of Science database. The aim is to discern the current state of research in the field, highlights and insights by meticulously analyzing the publication volume, authorship patterns, keyword co-occurrence, clustering, and timeline maps. The analysis reveals a notable increase in studies on corporate entrepreneurship in 2020, 2022, and 2023, with the most cited study being Dushnitsky & Lenox (2005), with 337 citations. Co-citation analysis highlights key themes related to CVC, including innovation, innovation strategy, external knowledge sources, alliance formation, and corporate entrepreneurship. The USA, Germany, and the UK produced the highest number of publications, with a concentration in the USA in 2016. This analysis demonstrates the historical and conceptual expansion of CVC in management and business literature, underscoring its significance as a mechanism for corporate innovation and strategic expansion.

Keywords: Corporate venture capital, CVC, bibliometric analysis.

Jel Classification: M1, O3

YÖNETİM VE İŞLETME LİTERATÜRÜNDE KURUMSAL GİRİŞİM SERMAYESİNİN BİBLİYOMETRİK ANALİZİ

Özet

Kurumsal Girişim Sermayesi (KGS) (Corporate Venture Capital-CVC), yönetim ve işletme alanlarında önemli bir ilgi odağı haline gelmiştir ve bu çalışma, kurumsal düzlemdeki değişen trendleri ve stratejik öncelikleri yansıtmaktadır. Araştırma, Web of Science veri tabanı kullanarak kurumsal girişim sermayesine ilişkin 1983 ve 2024 yılları arasında yönetim ve işletme kategorisindeki 281 veri üzerinden bibliyometrik analiz yöntemiyle analiz yapılmıştır. Amaç, yayın hacmini, yazarlık modellerini, ortak atıf analizini, kümelemeyi ve zaman çizelgesi haritalarını titizlikle analiz ederek alandaki araştırmaların mevcut durumunu, öne çıkan noktaları ve içgörüleri ortaya çıkarmaktır. Analiz sonuçlarına göre kurumsal girişimcilikle ilgili yönetim ve işletme alanındaki çalışmaların 2020, 2022 ve 2023 yıllarında bir artış gösterdiği, en yüksek atıf alan çalışmanın 337 atıf ile Dushnitsky & Lenox (2005) olduğu ve ortak atıf analizine göre kurumsal girişim sermayesine ilişkin çalışmaların merkezinde inovasyon, inovasyon stratejisi, harici (dış) bilgi kaynağı, ittifak oluşturma, kurum içi girişimcilik kavramlarının yer aldığı ortaya çıkmıştır. Yayın sayısı olarak ABD Almanya ve İngiltere iken 2016'da ABD'de yoğunlaştığı görülmüştür. Sonuç olarak, bu analiz, yönetim literatüründeki KGS'nin tarihsel ve kavramsal genişlemesini belirleyerek, onun kurumsal yenilik ve stratejik genişleme için bir mekanizma olarak önemini açıklığa kavuşturmaktadır.

Anahtar Kelimeler: Kurumsal girişim sermayesi, CVC, bibliyometrik analiz.

Jel Kodu: M1, O3

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1. INTRODUCTION

The term Corporate Venture Capital (CVC) refers to the direct investment of institutional funds in external venture companies (Chesbrough, 2002: 5). This definition excludes investments made through an external fund managed by third parties and excludes investments that fall under the more general concept of "corporate entrepreneurship". Corporate entrepreneurship entails the financing of new internal ventures that are distinct from a company's core business and, while having some organizational autonomy, remain legally part of the company. However, our definition includes investments in new ventures set up by a company as independent businesses (Chesbrough, 2002: 5).

CVC is used by companies to expand existing businesses and generate financial returns as the main objective. Research on CVCs has found that they have a diverse structure with both strategic and financial objectives in comparison to traditional Venture Capital (VC) (Burgelman et al., 2022: 3). The literature on CVC provides numerous examples of the entrepreneurial strategic objectives that companies pursue through their VC investments. These objectives include opening a technology window, utilizing internal technological developments, developing innovations with existing business units, creating demand for their own products, seeking acquisition targets, and entering foreign markets (Chesbrough, 2002).

The concept of CVC warrants thorough investigation due to its growing importance in fostering innovation and maintaining competitive advantage in the global market. As traditional R&D models become increasingly insufficient to keep pace with rapid technological advancements, CVC provides a vital alternative by enabling corporations to access external innovations and technologies. An increasing number of institutions began to consider establishing CVCs as a key component of their innovation strategies, both financially and strategically. Corporate executives have become aware about how to apply CVC to support their innovation initiatives and advancement of technologies within their industry. The current period is characterized by the professionalization and institutionalization of CVCs, marking a peak era. During this time, the capital and funds allocated to CVCs have become notable, and the impact of CVCs on the parent company, their relationship with portfolio companies, and the organization of the CVC unit have gained attention. This approach not only enhances the parent company's innovation capabilities but also offers strategic insights into emerging market trends and potential disruptions. Furthermore, CVC activities can influence broader corporate strategies, including foreign direct investment (FDI) and market expansion (FDI Intelligence, 2020). The sector saw substantial growth in 2021, with notable regional trends in the U.S., Europe, and Asia (Hu & Yacoob, 2024: 2).

The article aims to fill the gap in analysis of CVC by conducting a comprehensive bibliometric study using VOSviewer, focusing on high-quality literature from the past decade in the WOS database. Given these multifaceted benefits, understanding the dynamics, effectiveness, and strategic implications of CVC is essential for academics and practitioners aiming to optimize corporate growth and innovation strategies. This study aims to understand the current state of CVC, its roles in driving innovation, strategic growth, and the relationship

between corporate and its CVC arm. Bibliometric analysis is conducted to make a systematic literature review and to answer Research Questions (RQs):

RQ1: What is the publication and citation trends of CVC research?
RQ2: Who are the top contributors (i.e., journals, authors, countries) of CVC research?
RQ3: What does existing research inform about CVC research?
RQ4: What should future research be heading to advance CVC?

This research offers a critical review of the rapidly growing field of CVC. It contributes to understanding the current state of CVC research, identifies key themes and provides insights for future exploration in the field.

2. PHASES OF CVC

The history of CVC investment unfolds in distinct waves, each influenced by different trends and factors. The first wave emerged in the 1960s, inspired by the success of independent venture capital funds and driven by trends such as corporate diversification and surplus cash flow. About a quarter of Fortune 500 companies participated in CVC during this period, investing in both external start-ups and internal ventures. However, this wave was short-lived, as market downturns and reduced cash flow led to the closure of many CVC programs (Mason et al., 2019).

In the early 1980s, the second wave began with companies in industries like chemicals and metals establishing CVC programs. Legislative changes and the growth of the venture capital industry fueled this wave, but it faced setbacks with the market crash of 1987 The third wave, emerging in the 1990s and early 2000s, witnessed a surge in venture capital investing driven by technological advancements and the rise of Internet-related ventures. Many established corporations became significant players in the venture capital industry during this period despite facing declines due to market crises (Çavdar Çetin, 2019).

In the early 21st century, a new wave of CVC investing began, highlighting the cyclical nature of CVC investment. Despite economic challenges, many firms remained committed to CVC investments, recognizing the strategic importance of CVC for corporate innovation strategies. This period also saw the professionalization and institutionalization of CVC, with large sums of capital being allocated to CVC funds, such as SoftBank's $100 billion fund, although changes in investment strategy occurred later (Mason et al., 2019).

3. A MECHANISM FOR CORPORATE INNOVATION

Emphasizing innovation and long-term growth through investment and governance has always been a priority in corporate finance. As companies mature, they often face a decline in internal innovation (Lu & Li, 2024: 1). It's widely recognized how crucial innovation is for a business's survival in an ever-changing environment. CVC is a primary mechanism that large companies use to drive innovation alongside internal Research &Development (R&D) and innovation merger and acquisitions (M&As). CVC provides a valuable opportunity to access and

explore emerging technologies (Siegel et al., 1988) and plays a crucial role in enabling incumbents to actively participate in external R&D, thus fostering innovation (Keil, 2004; Fulghieri & Sevilir, 2009).

In recent years, CVC units have gained global importance across industries and technology sectors, helping companies remain agile and forward-thinking, and to cultivate new sources of growth. The CVC unit plays a unique role that is distinct from typical R&D or M&A departments. Its design should align with specific corporate strategic objectives (Strebulaev & Wang, 2024). Research has shown that each CVC organization is unique in its structure, objectives, and relationship with its investments. The most effective structure encourages innovation and is open to taking risks, whether the objectives are strategic or financial. Reporting structures and short or long-term goals can also differ among CVC organizations (Strebulaev & Wang, 2024).

We are currently in the midst of a booming era for CVC on a global scale. In recent times, CVCs have been exceptionally active, both in Turkey and around the world. Despite facing economic obstacles and a decrease in investments, data from the global Corporate Venturing (GCV) Institute shows that the decline in funding for startups backed by corporations has leveled off by 2023. Furthermore, 70% of the organizations that invested in startups in 2022 have resumed making additional investments. It has been noted that traditional venture capital investment is decreasing, and corporate-backed funding rounds have also followed suit. In 2023, there was a 27% decrease in CVC-backed startup funding rounds, with 3,894 transactions compared to 5,339 the previous year. CVC leaders have emphasized their ongoing commitment to investment but with a focus on supporting existing portfolio companies over making new investments. (GCV, 2024).

However, there has been an uptick in corporate investment in the last two quarters. In Q1 2024, there were 901 corporate-backed rounds, indicating a 4% increase from Q4 2023 (GCV, 2024). Figure 1 shows while the number of CVC investors remained stable, there was a noticeable increase in CVC-funded deals in the first quarter of 2024. Corporates especially invested in energy, AI and healthcare (Bain & Company, 2024).

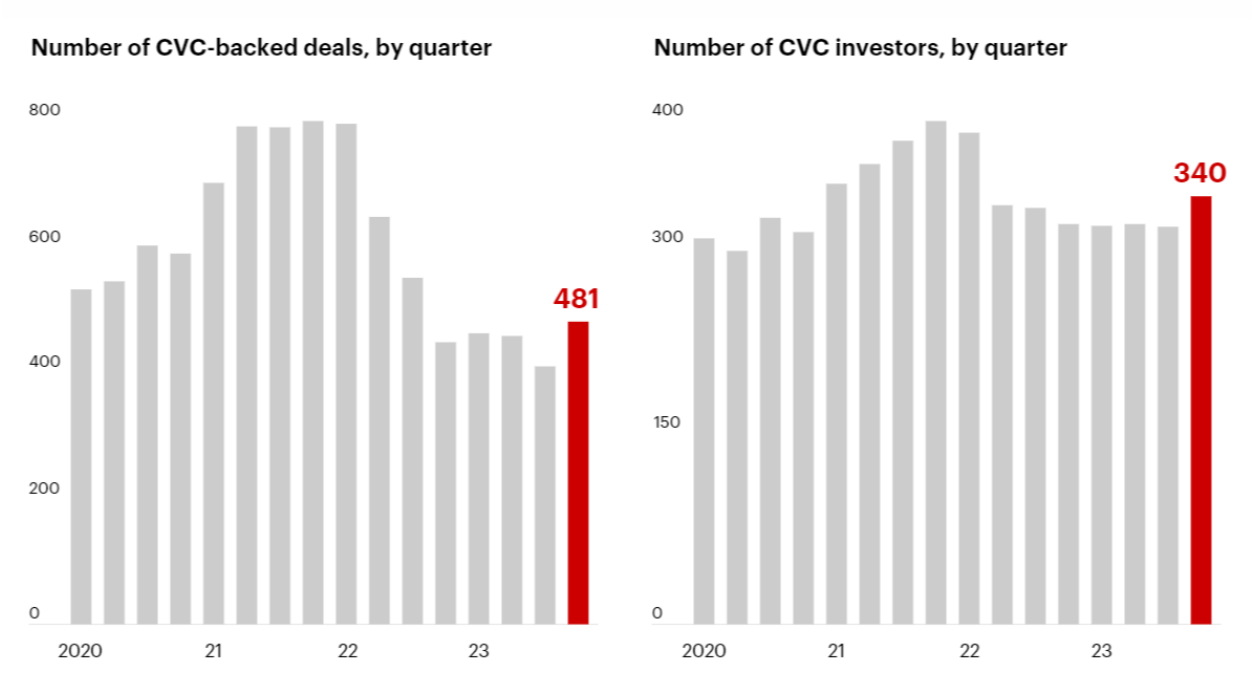

Figure 1. CVC Activity, Bain Global Venture Capital Outlook: The Latest Trends, 2024

As supported by global research, the number of CVCs and CVC investments have been increasing especially in recent periods. The number of CVCs in Turkey increased to 84 as of the end of May. Of these, 37% were finance, 25% were holding companies and 7% were technoparks. Other industries totaled 31%. In 2023, the participation rate of CVCs and institutions in investments was 38%. (Startups.watch, 2024).

In CVC literature there is a comprehensive analysis of CVC conducted by Huiwen and Yaacob (2024) and it utilizes two different databases (WOS and Scopus). This research is taken as reference and it aims to understand with which concepts CVC is addressed in the literature, when and why the number of publications increased and to provide guidance for future studies. For this purpose, bibliometric analysis is conducted to make a systematic literature review. This study utilizes bibliometric analysis to examine CVC from 1983 to 2024 within the management and business category, drawing from 281 data points from the Web of Science database.

4. RESEARCH METHODOLOGY

This research investigates the burgeoning field of CVC, specifically focusing on its role in fostering innovation, driving strategic growth, and illuminating the dynamic relationship between corporations and their CVC arms. The rapid rise of CVC, particularly within the Turkish investment landscape, necessitates a deeper understanding of global players and their practices. By analyzing current research on CVC, this study aims to not only contribute to the comprehension of the global CVC landscape, but also to identify key themes and illuminate promising avenues for future exploration within this critical field. Bibliometric Analysis was applied to study "Corporate Venture Capital" in the Web of Science (WOS) database management literature. Web of Science is introduced by Clarivate Analytics in 1964 as a well-established scientific citation indexing service across various disciplines (Huiwen & Yaacob, 2024: 3). The data obtained from this scientific analysis mapping technique were analyzed using the VOSviewer 1.6.17 program. Bibliometric analysis is an analytical technique that is often employed in systematic literature reviews-it involves the quantitative analysis of scholarly works (Lim & Kumar, 2023:1). Bibliometric analysis allows us to assess the productivity (publications) and impact (citations) of research, such as articles, and contributors like authors, institutions, countries/territories, funders, and subject areas within the field. This process aligns with "performance analysis," a significant aspect of bibliometric studies. (Lim & Kumar, 2023:1). Citation analysis, co-citation analysis, keyword co-occurrence analysis and bibliometric coupling were performed. The analysis showed that 281 publications related to CVC were published in WOS between 1983-2024, but 2024 studies cover only the first three months. After English language filtering, the number of publications was reduced to 280. When "Management" and "Business" are defined in the WOS category, we come across 193 publications on CVC. Figure 2 shows the filtering applied to the publications on CVC according to the search made on 30 March 2024 in WOS.

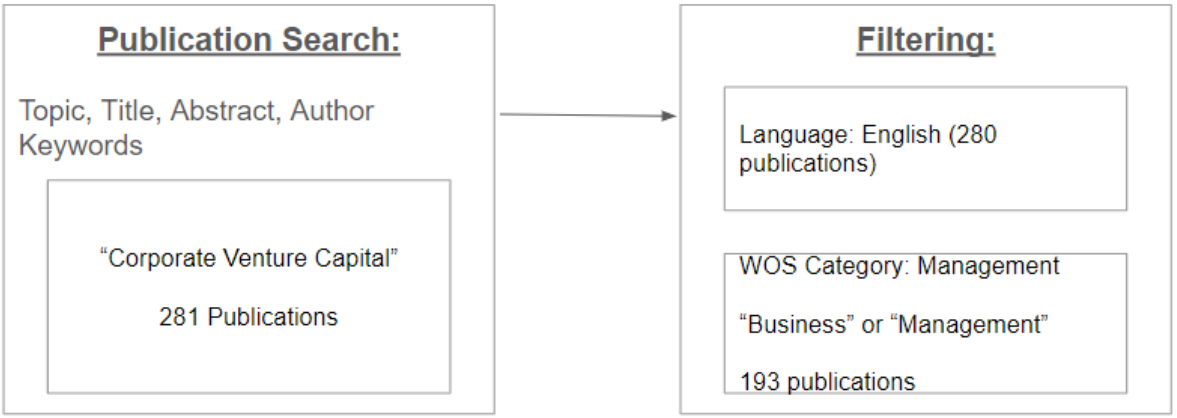

Figure 2. Research Flow Diagram

The studies mentioned above are included in the SSCI, ESCI, BKCI-SSH, SCI-EXPANDED, CPCI-SSH, BKCI-S, and CPCI-2S indexes.

4.1. Findings Related to Research

WOS database contains publications related to "CVC." After filtering the management category in WOS, 193 studies were identified, including 173 articles, 15 book chapters, 11 early access, 7 review articles, 5 proceeding papers, 4 letters, 3 corrections, 1 book, and 1 book review. In the process of searching for studies related to management in WOS, it was observed that the majority of the research on CVC was carried out in the "Journal of Business Venturing" and "Strategic Entrepreneurship Journal". Fourteen studies were conducted in each of these journals, with a focus on topics such as firm performance, firm value, innovation, and investment. Figure 3 shows the distribution of these studies in WOS.

Figure 3. Publication Titles of Relevant Sources on the Concept of CVC in the Field of Management and Business

Table 1. Number of Publications on CVC in WOS by Years

Publication Years	Publication Number
2024	5
2023	19
2022	17
2021	12
2020	17
2019	11
2018	8
2017	7
2016	14
2015	6
2014	6
2013	8
2012	6
2011	10
2010	9
2009	5
2008	6
2007	4
2006	5
2005	7
2004	1
2002	2
2000	1
1990	1
1987	1

Studies on CVC in the field of management and business administration have been carried out since 1987, according to the WOS database. The studies related to CVC have shown a significant increase between 2011 and 2024, especially in 2023, 2022, 2021, 2020, and 2016. The number of citations related to CVC has also increased significantly, particularly between 2020-2023, indicating a growing interest in the subject. The reasons for this increase will be re-evaluated in relation to co-occurence analysis. Also, investment rounds with Corporate Venture Capitalists (CVCs) have been on the rise worldwide since the start of 2020. This upward trend is projected to persist until the first quarter of 2022, signaling a burgeoning interest in CVC. To determine a meaningful relationship between years and citations, it may be useful to examine the citation distribution on a yearly basis. In this context, Figure 4 displays the citation distribution by year in order to observe the trends related to CVC.

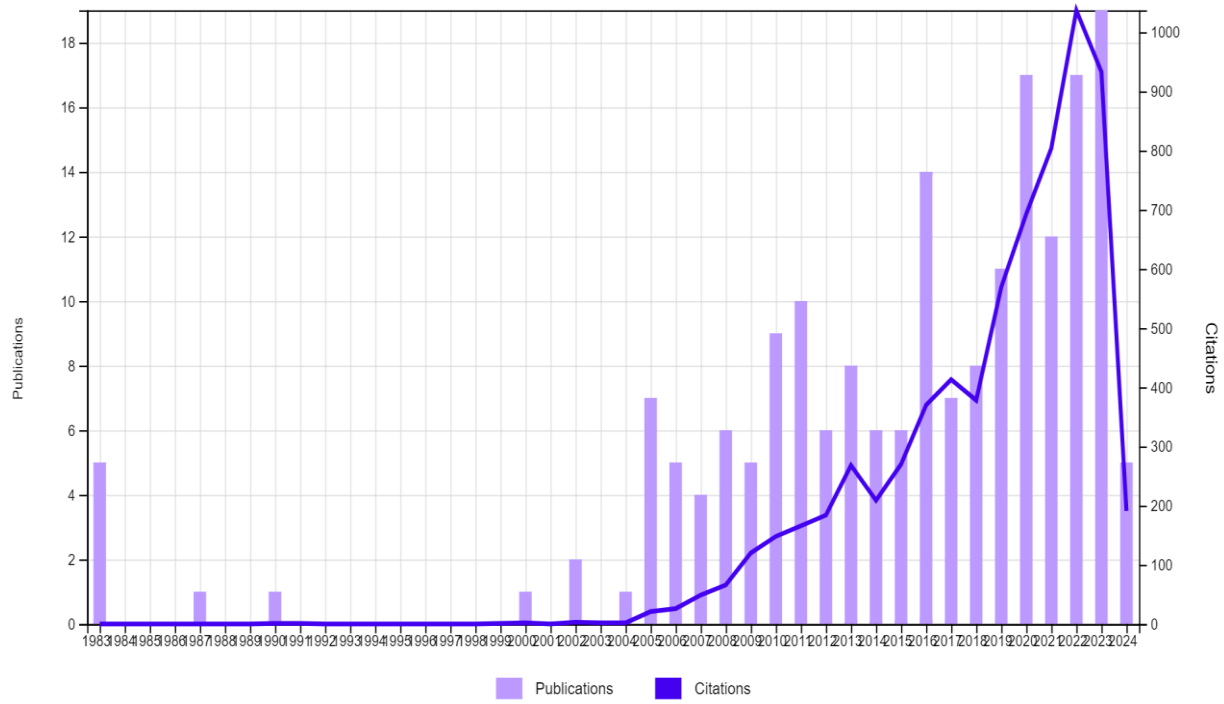

Figure 4. Citation Distribution of Publications on CVC in WOS by Years in the Field of Management and Business

Resource: (WOS 30th March, 2024).

In answer to the 1st Research Question, it is seen that there is a more intense interest in the concept of CVC in the literature as of 2020 and this is reflected in the number of publications. In Figure 4, it is shown that significant developments in the literature on CVC between 2020 and 2023 are evident, leading to an increase in publications and citations. As of 2019, the number of citations to publications has shown significant increases on an annual basis, and the number of citations in 2022 peaked and reached over 1000.

4.1.1. Findings on citation analysis

Citation analysis is a valuable method for tracking annual developments within a field (Heradia et al., 2016). It is employed to identify authors and publications that are frequently cited, as well as to track developments within the relevant discipline and related topics (Öztürk & Gök, 2020). Most of the publications on CVC are in the category of management (146) business (142) according to WOS categories. Majority of the publications are in the “Journal of Business Venturing" and "Strategic Entrepreneurship Journal. When we look at the countries where academic publications are made, USA (88), Germany (33), England (22), Italy (18), Switzerland (17) and France (14) are the most prominent countries.

Table 2 shows the distribution of the most cited authors, articles, and journals between 2020 and 2024. The grey boxes in the table show the highest number of citations received by the publications in the years indicated.

Table 2. Distribution of CVC Publications and Citations between 2020-2023

Authors	Publication	Citations					Total
		2020	2021	2022	2023	2024	
Dushnitsky, G and Lenox, MJ (2005)	When do incumbents learn from entrepreneurial ventures? Corporate venture capital and investing firm innovation rates	32	36	29	23	4	337
Wadhwa, A and Kotha, S (2006)	Knowledge creation through external venturing: Evidence from the telecommunications equipment manufacturing industry	26	28	24	22	4	296
Drover, W; Busenitz, L; (...); Dushnitsky, G (2017)	A Review and Road Map of Entrepreneurial Equity Financing Research: Venture Capital, Corporate Venture Capital, Angel Investment, Crowdfunding, and Accelerators	43	53	61	61	10	280
Zahra, SA and Hayton, JC (2008)	The effect of international venturing on firm performance: The moderating influence of absorptive capacity	23	30	29	17	2	279
Dushnitsky, G and Lenox, MJ (2005)	When do firms undertake R&D by investing in new ventures?	17	20	19	22	3	272
Dushnitsky, G and Lenox, MJ (2006)	When does corporate venture capital investment create firm value?	24	29	28	29	6	262
Markman, GD; Siegel, DS and Wright, M (2008)	Research and Technology Commercialization	19	28	15	20	3	223
Schildt, HA; Maula, MVJ and Keil, T (2005)	Explorative and exploitative learning from external corporate ventures	19	16	16	12	0	221
Dushnitsky, G and Shaver, JM (2009)	Limitations to Interorganizational Knowledge Acquisition: The Paradox of Corporate Venture Capital	14	26	18	26	6	204
Hill, SA and Birkinshaw, J (2014)	Ambidexterity and Survival in Corporate Venture Units	35	31	27	28	5	194
Chesbrough, HW (2002)	Making sense of corporate venture capital	13	13	16	11	2	194
Keil, T; Maula, M; (...); Zahra, SA (2008)	The effect of governance modes and relatedness of external business development activities on innovative performance	15	14	25	13	4	188
Narayanan, VK; Yang, Y and Zahra, SA (2009)	Corporate venturing and value creation: A review and proposed framework	7	13	14	14	5	171
Benson, D and Ziedonis, RH (2009)	Corporate Venture Capital as a Window on New Technologies: Implications for the Performance of Corporate Investors When Acquiring Startups	13	17	17	15	3	163
Keil, T (2004)	Building external corporate venturing capability	9	6	10	8	0	119

Resource: (WOS 6th April, 2024).

According to this table, the most cited studies on CVC and related concepts are Dushnitsky and Lenox (2005), Wadhwa and Kotha (2006) and Drover, Busenitz, Matusik, Townsend, Anglin, Dushnitsky (2017), Zahra, SA and Hayton, JC (2008), Dushnitsky, G and Lenox, MJ (2005) and Dushnitsky, G and Lenox, MJ (2006), respectively. In light of these data, it is observed that in the most cited studies, the concepts of technology entrepreneurship, CVC, innovation, appropriability (Dushnitsky & Lenox, 2005); technology, new business enterprises, venture capital - evaluation, telecommunication, investments (Wadhwa & Kotha, 2006); venture capital, CVC, angel investment, crowdfunding, accelerators, equity financing, entrepreneurship (Drover,

Busenitz, Matusik, Townsend, Anglin and Dushnitsky, 2017) are associated with CVC. This situation regarding the most cited studies related to the concept is supported by the visual in Figure 5.

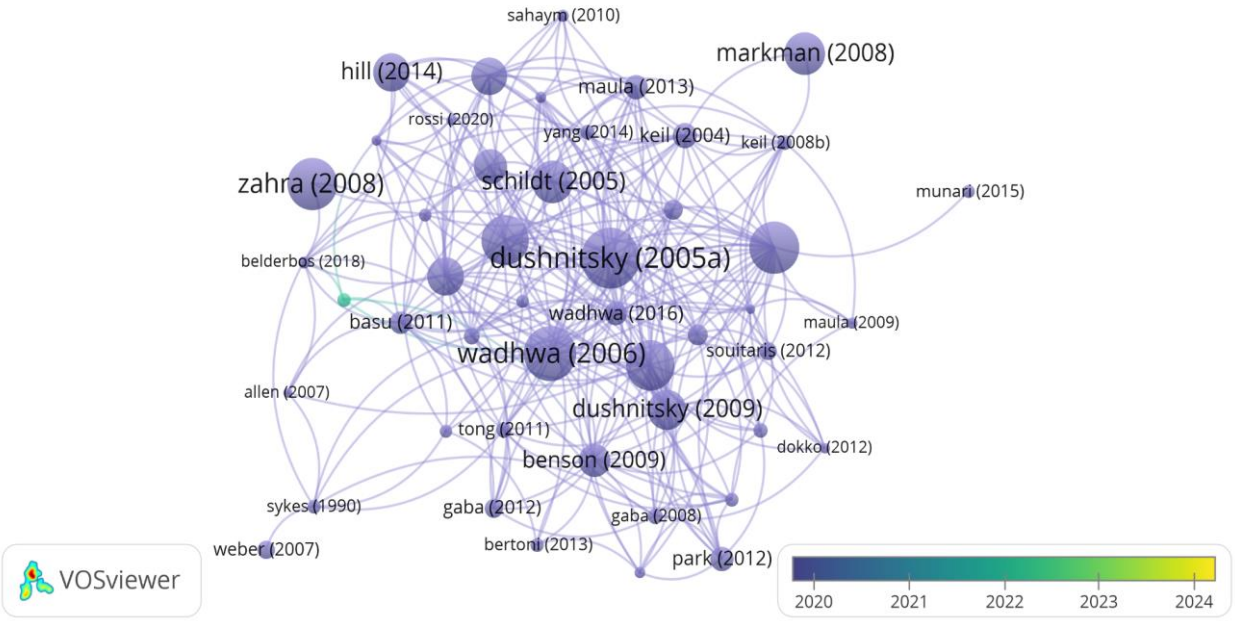

Figure 5. Citation Network on CVC between 2020-2024

In order to better visualize the most frequently cited studies on CVC, Figure 6 displays their density.

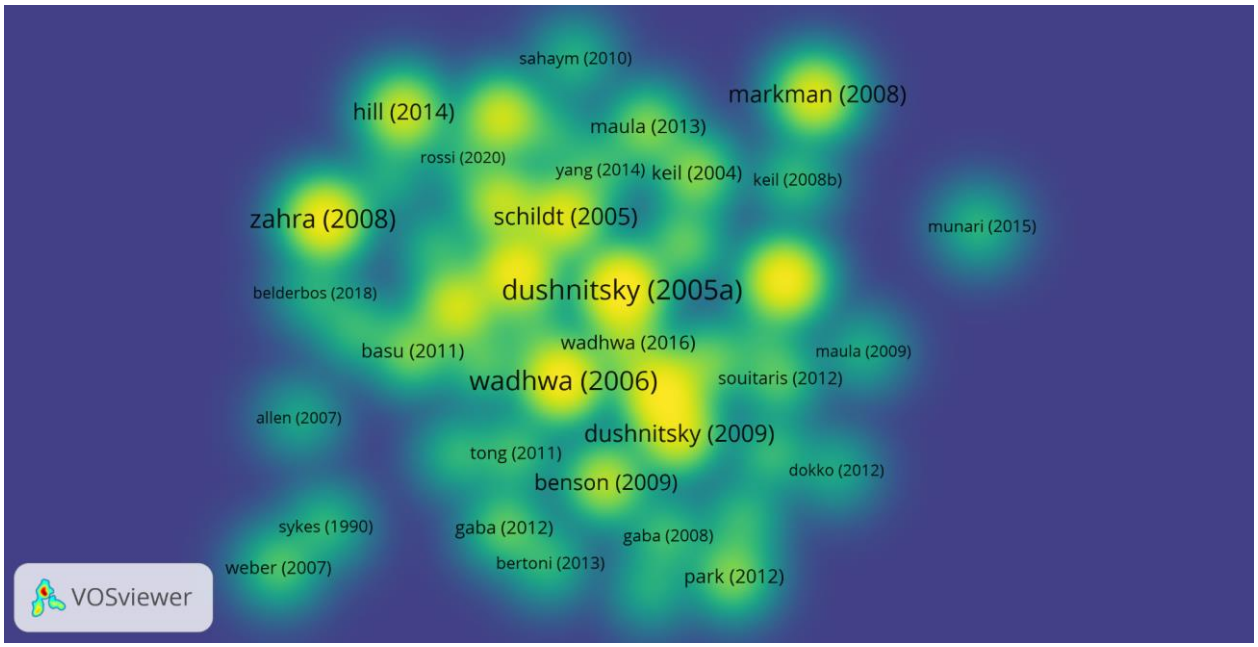

Figure 6. Density Network of Cited Studies on CVC in Management

Dushnitsky & Lenox (2005a) focus on exploring the potential innovative advantages of CVC, which involves equity investments in entrepreneurial ventures by established firms. They suggest that CVC programs have the potential to significantly contribute to capturing innovations from entrepreneurial ventures and should therefore be a critical component of a firm's overall innovation strategy. The due diligence, post-investment, and a failing venture may provide firm learning in different ways in CVC activity. Also, intellectual property-wise, CVC may be a uniquely advantageous strategy for gaining a window into entrepreneurial technologies in weak IP regimes. They also propose that the impact of investment in entrepreneurial ventures on firm innovation rates will be more significant for those firms that have a strong base in innovation. Their findings in research suggest that CVC programs play a significant role in firms' innovation strategies and may serve as a crucial component of their innovation toolkit, particularly in environments where access to external knowledge is vital. In another article, Dushnitsky and Lenox (2005b) discovered that firms tend to invest more in new ventures, also known as "CVC" in industries with weak intellectual property protection. Additionally, they found that firms are more likely to invest in industries with high technological ferment and where complementary distribution capability is important. The study also revealed that firms with greater cash flow and absorptive capacity are more inclined to invest. These findings indicate that in Schumpeterian environments, established companies may enhance their innovative efforts by leveraging the knowledge generated by new ventures.

Wadhwa & Kotha (2006) found that established firms are increasingly investing in entrepreneurial ventures to gain insights into new technologies and markets. Their study, which analyzed panel data from corporate investors in the telecommunications equipment manufacturing industry, revealed that the impact of CVC investments on knowledge creation is influenced by the level of investor involvement. Specifically, the researchers observed that a low level of investor involvement is associated with an inverted U-shaped relationship between the number of CVC investments and innovation performance. Conversely, a high level of investor involvement reverses this relationship, leading to an increase in investments and boosting innovation.
The study by Drover et al. (2017) emphasizes the importance of venture capital in entrepreneurship and the launch of high-growth ventures. It explores various aspects of venture financing and points out that while most research has focused on venture capital (VC), attention is now turning to other forms, such as angel investment, corporate CVC, crowdfunding, and accelerators. The review highlights the need to study the differences among equity investors and their interactions across different categories. Broadening the scope of inquiry is essential for understanding the changing landscape of entrepreneurial financing. The text advocates for careful theorizing and empirical studies to drive practical changes and enhance theoretical understanding in this area. There appears to be increased interest in this work, particularly in 2021, 2022 and 2023.

According to Zahra and Hayton (2008), a company's absorptive capacity plays a key role in shaping the connection between international venturing and financial performance. It is crucial for executives to prioritize investments in internal R&D and innovative capabilities in order to effectively harness knowledge from foreign markets.

Dushnitsky & Lenox (2005b) propose that CVC investment creates greater firm value when firms pursue CVC to harness novel technology. They present evidence using a panel of CVC investments that supports their proposition. The paper also discusses the potential challenges and benefits of CVC for financially oriented firms, highlighting the importance of CVC as a tool for creating firm value through access to novel technologies and practices.

The most cited publications on Corporate Venture Capital (CVC) focus on its strategic role in fostering innovation, its impact on corporate performance, and its differentiation from independent venture capital (IVC). Key studies highlight how CVC investments serve as a tool for accessing new technologies and gaining market intelligence, emphasizing the strategic alignment with parent company goals. Additionally, these works explore the network advantages of CVC, showing how connections to established companies enhance investment performance and innovation outcomes.

The leading contributors to CVC literature include prominent journals such as the Journal of Business Venturing, and the Strategic Management Journal. Notable authors in the field include Gary Dushnitsky, known for his work on corporate entrepreneurship, Michael J. Lenox. The United States, Germany, and the United Kingdom are the top countries contributing to CVC research, reflecting the global interest and impact of CVC on corporate strategy and innovation.

4.1.2. Findings on co-occurrence of keyword and cluster Analysis

Keyword co-occurrence analysis, a fundamental method in scientometrics for analyzing document content, is essential for comprehending the landscape of research on CVC (Huiwen & Yaacob, 2024:9). In the CVC literature, citation and publication analyses can reveal the focal points of studies on the concept. Figure 7 shows the study clusters obtained by combining keywords and cluster analysis of 193 studies in the management and business categories related to CVC in WOS.

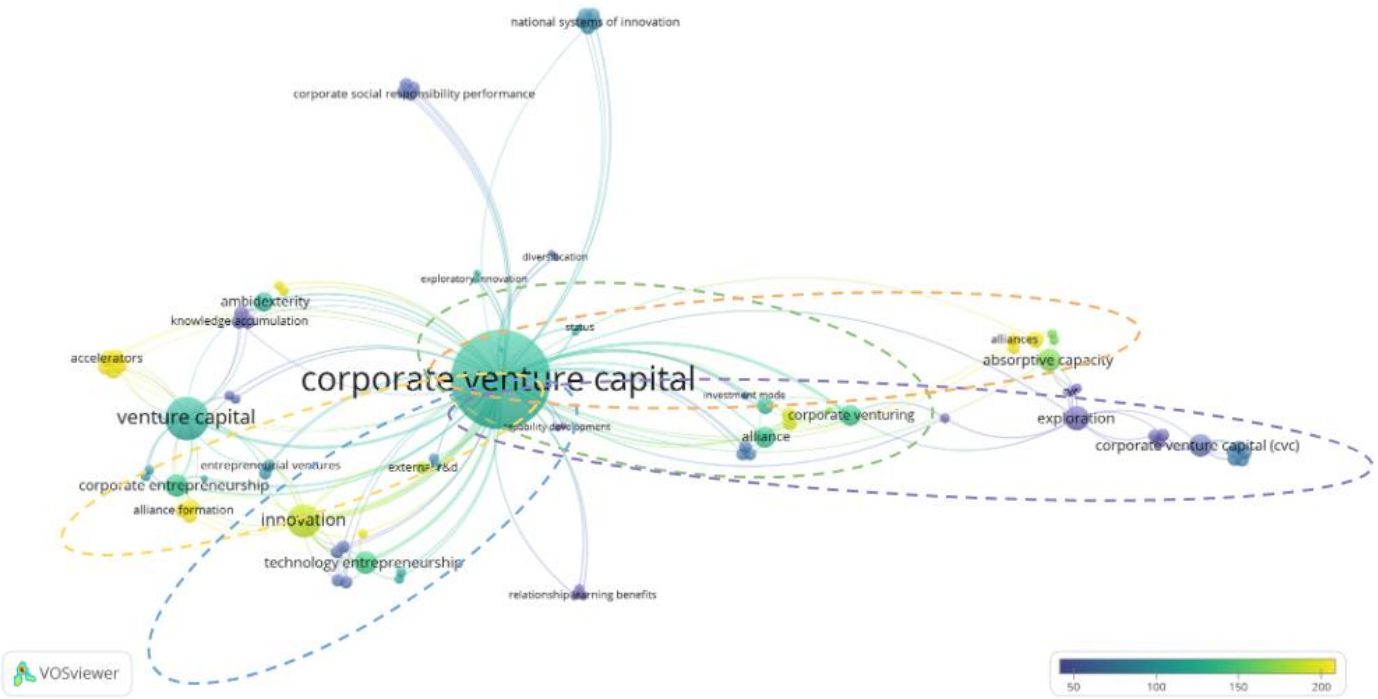

Figure 7. Co-occurrence of Keywords

As shown in Figure 7, innovation, CVC, and corporate entrepreneurship are the focal points of the studies on CVC . Based on the comprehensive analysis of the publications in WOS, five main clusters of studies on the concept are evident. Figure 8 provides a clearer representation of the concepts within these clusters.

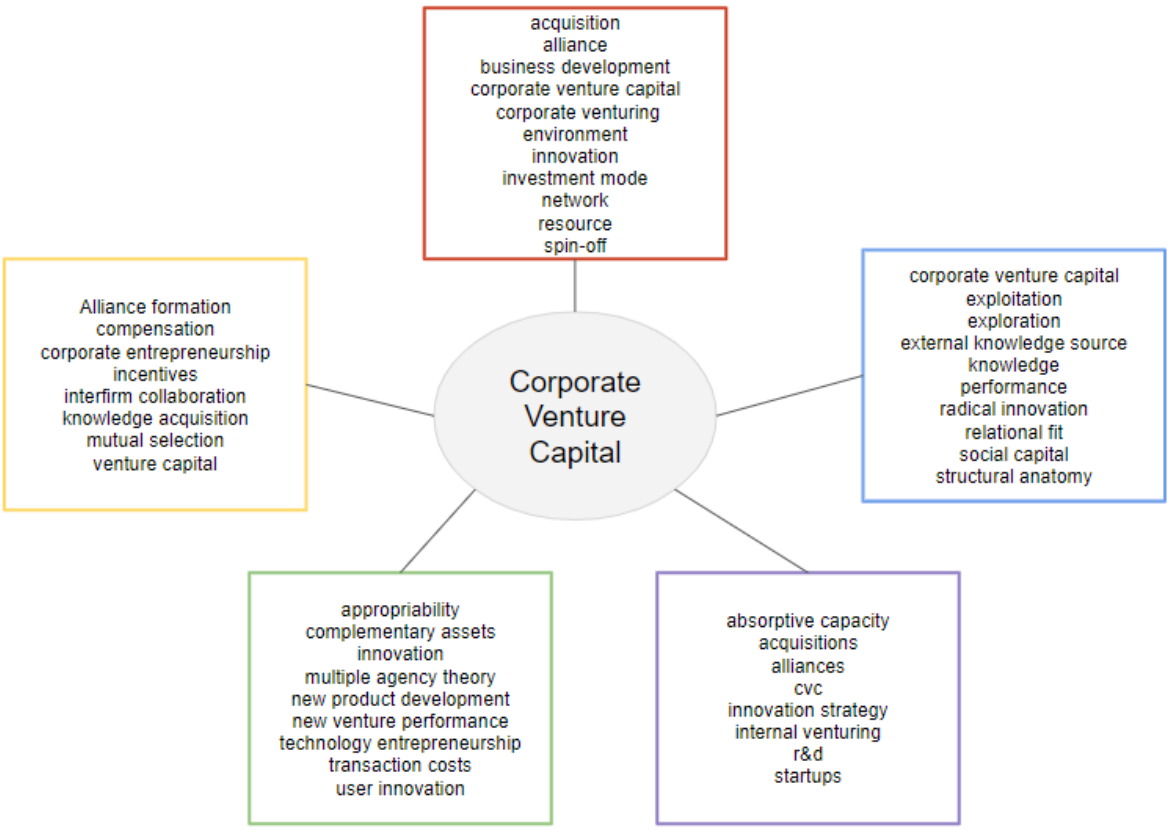

Figure 8. Clusters Related to Concepts Associated with CVC in WOS

In Figure 8, different clusters are identified based on their focus areas in CVC. The red cluster can be named as strategic value and business development, as it explores how CVC activities align with broader corporate strategies, emphasizing business development through acquisitions, alliances, and innovation. The green cluster can be named as innovation and new venture performance as it examines the impact of CVC on innovation and new venture performance, highlighting the role of complementary assets and technology entrepreneurship. The blue cluster can be named as knowledge integration and radical innovation as it investigates the role of CVC in integrating external knowledge to foster radical innovation and enhance performance through exploration and exploitation activities. The yellow cluster can be named as corporate entrepreneurship and collaboration as it focuses on how CVC facilitates corporate entrepreneurship and collaboration between firms, including incentive structures and knowledge acquisition. Lastly, the purple cluster can be named innovation strategy and internal venturing as it focuses on the strategic aspects of innovation, including absorptive capacity, internal venturing, and the formation of alliances to drive R&D and startup growth.

This study focuses on constructing a literature map on CVC by emphasizing the "country" network node (Huiwen & Yaacob, 2024:7). Figure 9 shows citation analysis of countries.

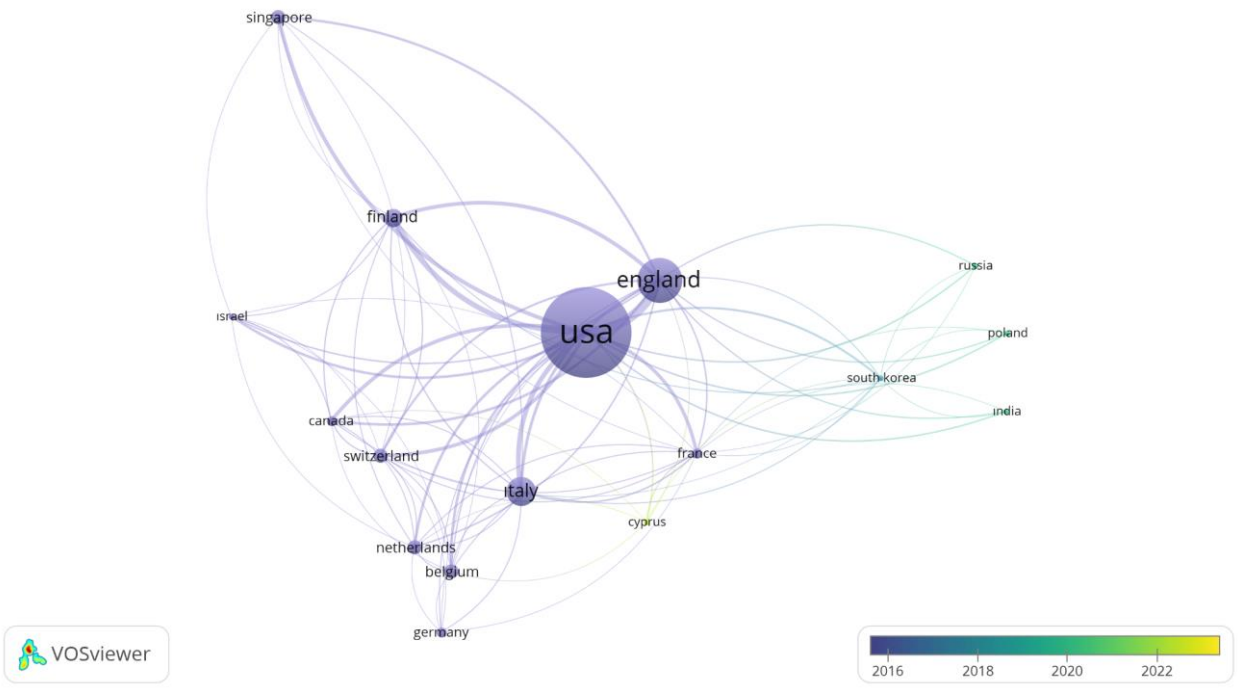

Figure 9. Citation Analysis of Countries Related to CVC

It is emphasized in the figures and tables previously shared that the academic interest in CVC has gradually increased especially in 2016, 2020, 2022, and 2023. Figure 8 shows that publications in the field were concentrated in the USA, England, and Italy in 2016. In 2018, it was concentrated in South Korea, and in 2020 in Poland, India, and Russia. In 2022, it is concentrated in Cyprus. The USA generally has the highest number of corporate CVC. When we look at the percentage of quarterly deals by global region in the last quarter of

2023, the breakdown was as follows: US 29%, Asia 42%, Europe 22%, Latin America 2%, Canada 2%, and all other regions 3%. Therefore, the highest number of CVC deals and investments are realized in the US, Asia, and Europe. These regions also have a high number of publications covering CVC activities. In Turkey as of the end of May, the number of CVCs in Turkey increased to 84 and in 2023 the participation rate of CVCs and institutions in investments was 38% (Startups.watch, 2024).

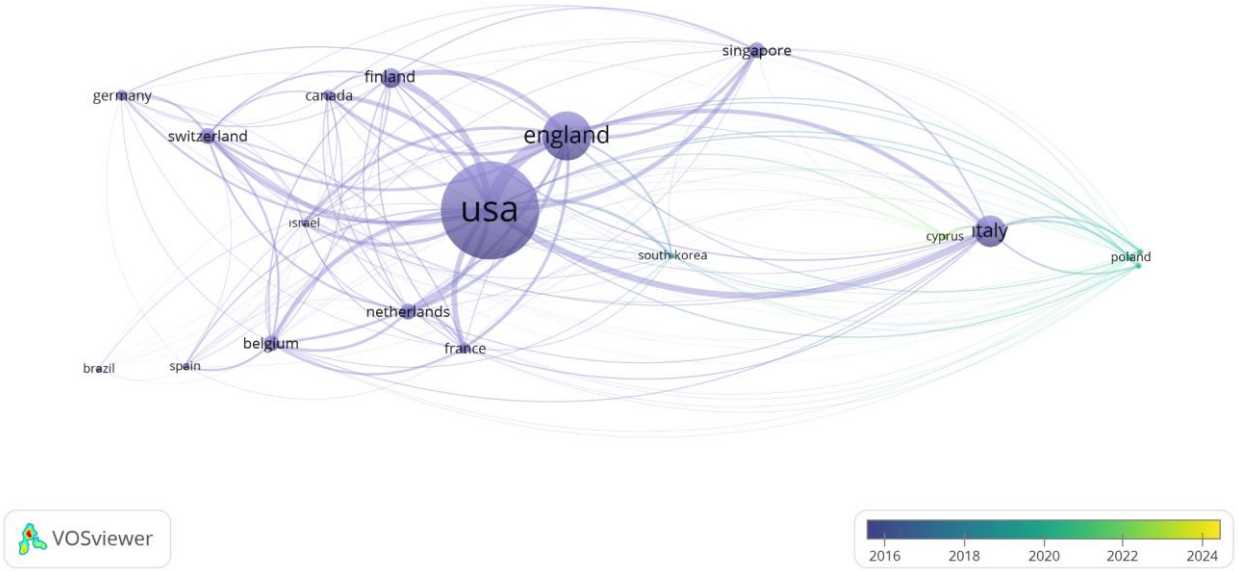

Figure 10. Bibliometric Coupling of Analysis on CVC in Management

Figure 9 shows that bibliometric matching is performed on the basis of countries. The increase in the thickness of the link means an increase in cooperation between the countries at both ends of the link. In this context, it is observed that the cooperation between the USA and the UK, the USA and Finland, and the USA and Italy increased especially in 2016.

Existing research on CVC highlights its strategic importance for fostering innovation and maintaining competitive advantage. Historical analysis shows that CVC has evolved through various waves, each reflecting different market conditions and strategic goals. Key research clusters focus on the alignment of CVC with corporate strategy, the facilitation of corporate entrepreneurship, the impact on innovation and new venture performance, and the integration of external knowledge for radical innovation. Prominent contributors to CVC research include top journals like the Journal of Business Venturing, influential authors such as Gary Dushnitsky and Michael J. Lenox, and leading countries including the United States, Germany, and the United Kingdom.

5. CONCLUSION

The bibliometric analysis of Corporate Venture Capital (CVC in management and business literature reveals a dynamic and expanding field of study. The research demonstrates an evident growth in academic interest, particularly highlighted by the surge in publications and citations from 2016 to 2024. Through comprehensive data analysis, it is evident that CVC is a crucial element for corporate innovation and strategic entrepreneurship and plays a pivotal role in shaping global investment patterns and technological advancements. The thematic clusters uncovered through this study—ranging from innovation and corporate entrepreneurship to international venturing—underscore the multifaceted impact of CVC on business development and firm performance.

Moreover, the geographical distribution of publications may be a sign of a shift in focus towards emerging markets and non-traditional regions, reflecting the global nature of venture capital investment. This shift is particularly notable in the increasing engagement of countries like Cyprus, Poland, India, and Russia, alongside the consistent prominence of the United States. The study also identifies a trend towards more collaborative and cross-country research efforts, indicating a broadening scope of CVC studies.

In conclusion, this bibliometric analysis maps the historical contours and current state of CVC research and illuminates its critical role in driving innovation, strategic growth, and global entrepreneurship. As CVC continues to evolve, it remains an essential area for further scholarly exploration, particularly in understanding its impact on technological development, corporate strategy, and economic growth.

5.1. Recommendation for Future Studies

Based on the article, future research on CVC should delve into several promising areas. One potential area could be to investigate the role of CVC in fostering technological development and economic growth in emerging markets. The interplay between CVC and startup ecosystems in emerging markets presents a fertile ground for exploration, offering insights into how CVC can support technological diffusion and innovation in these regions. Another direction could involve exploring the strategic partnerships and collaboration models that CVC fosters between corporations and startups. This includes assessing how these alliances impact both parties' innovation capabilities, particularly in rapidly evolving industries like AI and clean technology. In addition to technological development and economic growth, future research on CVC could explore how companies align their CVC strategies with their broader corporate objectives and investment theses. This alignment is crucial in ensuring that CVC investments contribute to long-term corporate goals while fostering technological innovation. Finally, longitudinal studies examining the long-term outcomes of CVC investments on both the investing corporations and the venture companies would contribute significantly to our understanding of CVC's strategic value.

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BIBLIOMETRIC ANALYSIS OF UNIVERSITY-BASED INCUBATION CENTERS IN THE STARTUP ECOSYSTEM

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Abstract

Today, with the emergence of digital transformation, the roles of universities have changed. In line with the needs of industrialized society, universities have transformed from research-oriented institutions to institutions that contribute to economic and social development. In the United States, incubators that emerged in the form of "Science Parks" close to universities have evolved continuously and are in direct relationship with startups and universities. The development and success of startups, which have started to play an important role in the economic development of countries, are associated with universities and incubation centers. In the literature, university-based incubators are frequently examined in the context of digital transformation, especially in relation to startups and universities. It was decided to use the Bibliometric Research Method to predict the developments in the literature on the concept of university-based incubators and the topics that may be linked in the future in order to find out how it shows a trend and trend in the literature in all categories. In this context, the concept of "University Based Incubation Center" was searched in the Web of Science (WOS) database between 2000 and 2024, including March 27, 2024. The distribution of publications on the concept of university-based incubation center in WOS between 2000-2024 was determined according to the categories of publications and the distribution of publications on university-based incubation center was determined.

Keywords: University based incubators, university, startup.

Jel Classification: L26

STARTUP EKOSİSTEMİNDEKİ ÜNİVERSİTE TEMELLİ KULUÇKA MERKEZLERİNİN BİBLİYOMETRİK ANALİZİ

Özet

Günümüzde dijital dönüşümün ortaya çıkmasıyla birlikte üniversitelerin rolleri de değişmiştir. Sanayileşmiş toplumun ihtiyaçları doğrultusunda üniversiteler araştırma odaklı kurumlardan ekonomik ve sosyal kalkınmaya katkı sağlayan kurumlara dönüşmüştür. Amerika Birleşik Devletleri'nde üniversitelere yakın "Bilim Parkları" şeklinde ortaya çıkan kuluçka merkezleri sürekli gelişerek startuplar ve üniversiteler ile doğrudan ilişki içerisine girmiştir. Ülkelerin ekonomik kalkınmasında önemli bir rol oynamaya başlayan startupların gelişimi ve başarısı üniversiteler ve kuluçka merkezleri ile ilişkilendirilmektedir. Literatürde üniversite tabanlı kuluçka merkezleri dijital dönüşüm bağlamında özellikle startuplar ve üniversiteler ile ilişkili olarak sıklıkla incelenmektedir. Üniversite tabanlı kuluçka merkezleri kavramına ilişkin literatürdeki gelişmeleri ve gelecekte ilişkilendirilebilecek konuları tahmin etmek, tüm kategorilerdeki literatürde nasıl bir eğilim ve trend gösterdiğini tespit etmek amacıyla Bibliyometrik Araştırma Yöntemi'nin kullanılmasına karar verilmiştir. Bu kapsamda "Üniversite Tabanlı Kuluçka Merkezi" kavramı Web of Science (WOS) veri tabanında 27 Mart 2024 tarihi de dâhil olmak üzere 2000-2024 yılları arasında taranmıştır. WOS'ta 2000-2024 yılları arasında üniversite tabanlı kuluçka merkezi kavramı üzerine yapılan yayınların kategorilere göre dağılımı belirlenerek üniversite tabanlı kuluçka merkezi üzerine yapılan yayınların dağılımı belirlenmiştir.

Anahtar Kelimeler: Üniversite temelli kuluçka merkezi, üniversite, startup.

Jel Kodları: L26

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* This study is derived from a thesis in the PhD programme in management and strategy at Istanbul University.

1. INTRODUCTION

In parallel with the advancement of technology worldwide, the expectations of individuals have changed, leading to changes in the economic and social structures of countries. The development of countries' economies and social structures is possible through the widespread promotion of entrepreneurial activities. As Romer (1986) and Lucas (1988) have noted, entrepreneurial activity contributes to economic growth as a catalyst for disseminating knowledge, increasing competition, and bringing diversity to the economy.

Entrepreneurship, a concept as ancient as human history itself, has undergone various stages over the millennia in response to the needs and expectations of people from ancient times to the present. In the early 18th century, Richard Cantillon, who first introduced entrepreneurship in economic literature, defined an entrepreneur as someone who buys and sells goods or services for a price, encompassing both the inputs and outputs of production (Tosunoğlu, 2003: 4-5). John Baptiste Say, in classical economics, extensively addressed the concept of entrepreneurship, arguing that economic development is directly proportional to entrepreneurial activity (Peneder, 2009; 80). Austrian economist Joseph Schumpeter, meanwhile, reinterpreted entrepreneurship, laying the groundwork for the idea that remains relevant today (Çetindamar, 2002: 35). In the contemporary context, entrepreneurship is not solely about creating something new, but also about fostering innovation by reshaping existing paradigms or adopting approaches that enable transformation (Fossatti, 2021: 3). In this context, entrepreneurs can consider a broader range of social and environmental values, beyond purely financial goals that dominate linear logic, by taking into account the impacts on nature and other stakeholders (Anand, 2021).

At the beginning of the 21st century, the world entered a period of rapid change, during which all concepts began to be affected and shaped. In this process, entrepreneurship diversified into subcategories, and the desires and expectations of entrepreneurs also evolved. Now, beyond just having an innovative idea, the creative commercialization of that idea and its subsequent sustainable scalability have become increasingly important. Especially in this period, the role of universities has begun to be seen as a significant source of economic growth in the innovative context, providing knowledge (technology). In line with this, universities have adopted the definition of entrepreneurial universities, contributing to economic impacts through the creation, attraction, and retention of talented human capital and entrepreneurs (Bramwell & Wolfe, 2008).

Just as noted by Clearly (2002), universities now play a role that goes beyond the narrow economic and technical approach shaped by intermediary units such as technology transfer and regional development offices, spin-off companies, and science parks. Universities, research institutes, industry, and government increasingly recognize the importance of collaboration in science and technology to promote sustainable industrial, economic, and social development. Particularly, education and innovation in engineering, science, and technology play a crucial role in bridging the gap between developed and developing countries (Lalkaka, 2005: 2) Universities have increasingly expanded their roles beyond traditional teaching and research, promoting local development through innovative activities that generate economic, social, and cultural value (Thomas et al., 2021).

In line with this, incubation centers, which initially undertook the task of providing entrepreneurs with central infrastructure and office spaces in their early years, have expanded the scope of services they offer to entrepreneurs over the years. Nowadays, incubation centers are seen as a contemporary business model worldwide, facilitating the commercialization of ideas, the growth of ventures, and the development of their respective regions through their evolving financial structures (Lalkaka, 2001: 6). This change is viewed as a leveraged effect in fostering the commercialization of entrepreneurs' ideas, the expansion of ventures, and the development of the region they are located in (Suk & Mooweon, 2006: 30).

The concept of university-based incubation centers is a multidimensional collaborative effort, thus making it a subject of interdisciplinary studies from various fields. Therefore, there is a need for comprehensive studies that synthesize the findings of previous research. For this reason, bibliometric measurement technique is preferred in this study.

The concept of entrepreneurship has become a determining factor for the socio-economic development of modern societies. Progress is now measured by the prevalence and effectiveness of entrepreneurial activities within a society. As entrepreneurial activities become increasingly critical worldwide, the stages preceding the commercialization of an idea are of vital importance for the long-term success of entrepreneurship. In this context, university-based incubation centers, which focus on developing the entrepreneurship ecosystem, emerge as significant elements that not only contribute to the generation of new knowledge and human capital but also support the entrepreneurial spirit (Özdoğan, 2016).

This study conducts a systematic literature review focusing on university-based incubation centers (UBIs), utilizing bibliometric analysis of 165 studies identified in the Web of Science. The review aims to provide a comprehensive overview of the past, present, and future of UBIs, while also offering a framework that encompasses the theoretical foundations of this field.

The literature predominantly examines UBIs through the lens of their benefits, such as access to university knowledge and resources, entrepreneurship training, and mentorship support (Audretsch, 2014; Çetindamar, 2002). This aligns with theoretical frameworks emphasizing UBIs' role as a "bridge" within the entrepreneurial ecosystem and highlighting their position in the "triple helix" model of innovation (Etzkowitz & Leydesdorff, 2000).

However, this dominant perspective often overlooks potential drawbacks and criticisms of UBIs. Some research suggests that their focus on commercialization may marginalize alternative models like social entrepreneurship (Nicholls, 2010) or detract from universities' core missions of teaching and research (Pappas, 1997). Additionally, concerns have been raised about UBIs potentially threatening academic freedom and autonomy (Slaughter & Leslie, 1997).

This study aims to provide a broader, more critical perspective by comparing different theoretical perspectives on UBIs (e.g., resource dependence theory, network theory, institutional theory) and the critiques they raise. By highlighting both positive and potentially problematic aspects, this research seeks to shed light on the future development of UBIs.

This study contributes significantly to the understanding of UBIs in the modern world, offering valuable insights into how startups can survive and thrive, and how these centers can actively contribute to their development. The insights gleaned from this study are invaluable not only for scholars seeking to advance academic discourse but also for practitioners in the business world, guiding both academia and industry towards a more informed, efficient, and startup-focused future.

A key finding of this study is the identification of UBIs as a crucial bridge in the context of digital transformation and as a means to better understand the complex landscape of startups. From this perspective, UBIs emerge as significant tools in the development of entrepreneurship, revealing nuanced aspects that may be overlooked in the broader startup ecosystem.

Using bibliometric research methodology, this study analyzes developments in the literature related to UBIs, identifying trends and potential future research topics. This approach allows for a comprehensive and systematic examination of the rapidly evolving field of UBI research, synthesizing existing knowledge, identifying gaps, and suggesting future research directions as the startup ecosystem continues to evolve.

The bibliometric characteristics of articles published on university-based incubation centers in the Web of Science (WoS) database are examined. In this regard, the following research questions are addressed:

RQ1: How has the trend of studies and citations on university-based incubation centers evolved over time?
RQ2: In which fields are studies on university-based incubation centers conducted?
RQ3: Who are the authors with high relationship strength in studies on university-based incubation centers?
RQ4: What are the most researched keywords in studies on university-based incubation centers?

2. UNIVERSITY-BASED INCUBATION CENTERS

Global and dynamic competitiveness has emerged as a revival of the higher education system, alongside the superiority of human resources, high standards of quality research, creativity, innovation, and entrepreneurship, coupled with cost and productivity efficiency (Mok, 2005: 540). Building upon this, universities have undergone profound changes to adapt to the new developments worldwide, becoming significant instruments of economic development in the knowledge-based economy (Wissema, 2014: 1). Universities, which were once solely focused on knowledge production (Bruneel et al., 2010: 860), have now shifted their focus to new missions aimed at societal development and economic growth (Schulte, 2004: 187). In this regard, Audretsch (2014), evaluating the shift of universities towards a more facilitating and entrepreneurially encouraging direction, also

underscores their significant role as institutions that produce and disseminate knowledge (Kirby, 2005: 561).

Over the past few decades, universities have undergone a transformation in their core activities to structure entrepreneurial ecosystems with the aim of providing multiple employability alternatives such as self-employment, academic entrepreneurship, or entrepreneurially-minded employees (Audretsch, 2014: 315). In this regard, universities have emerged with the entrepreneurial university model as part of the economic and social development process, in addition to their traditional education and research activities (ArroyoVazquez et al., 2010: 65).

In this context, an entrepreneurial university is defined as a university that simultaneously performs three core activities: teaching, research, and entrepreneurship, while also providing an adequate educational environment (Guerrero & Urbano, 2012: 57). Since the recognition of the "Batavia Industrial Center," founded by Joseph Mancuso in Batavia, New York, in 1959, as the world's first business incubator (Albert & Gaynor, 2000: 7), incubators worldwide have become widespread, adopting different names and practices for various purposes (Aernoudt, 2004: 128). Especially since the 1980s, incubators have undergone several stages of evolution, leading to their classification into first-generation incubators, university-based incubation centers second-generation incubators, third-generation incubators, and fourth-generation incubators (Soy, 2015).

Incubators, which emerge as structures aiming to accelerate the development of new entrepreneurs and subsequently enable them to stand on their own feet (Özdoğan, 2016: 116), are generally defined as facilities that provide shared office working spaces to entrepreneurs and offer strategic and value-added monitoring and business consultancy (Hackett & Dilts, 2004: 58). According to Pappas (1997), who defines incubators as a dynamic process aimed at nurturing and supporting emerging commercial enterprises or individuals, they are structures that help young firms survive and grow during their most vulnerable initial period, when they are most susceptible to failure. These structures nurture young firms to help them weather the challenges of infancy and thrive. With a network comprising individuals and organizations such as university communities and industry connections, which are professional service providers (Hackett & Dilts, 2004: 57), incubators facilitate the development of supportive systems and provide conducive conditions for enterprises to successfully survive (Lumpkin & Ireland, 1988: 60).

Since the 1980s, with the impact of globalization, universities' traditional roles of fulfilling research and education functions have undergone a transformation, evolving into centers for supporting innovation and enhancing economic development through knowledge transfer (Youtie & Shapira, 2008: 1189). Among the various types of support, university-based incubation centers have gained prominence (Grimaldi & Grandi, 2005: 114), assuming a role in supporting the development of research and technology-based firms established within or around university campuses. In this regard, university-based incubation centers established institutions embraced by governments, support and nurture spin-offs and small to medium-sized enterprises during their development and growth stages, contributing to the economy (Studdard, 2006: 77). Many incubators worldwide

receive support from universities. Particularly, university-based incubation centers, which have become an increasingly prevalent trend in the development of incubators, offer more extensive support to entrepreneurs compared to other incubator programs (Culkin, 2013: 637). University-based incubation centers, not limited to serving entrepreneurs alone, possess robust infrastructure in terms of human expertise, financial resources, and strategic locations, enhancing innovation and commercialization (Chandra et al., 2012).

3. METHODOLOGY

The bibliometric analysis method was preferred in this study due to its ability to evaluate the structure and dynamics of the research field at a macro level. Data obtained from bibliometric analysis were subjected to various analysis techniques using the VOSviewer 1.6.16 software.

When selecting the database for the study, criteria such as the number of journals containing articles on university-based incubation centers, ease of access to the database, availability of data download in a file format compatible with bibliometric analysis software packages, and the ability to provide desired filtering to answer research questions were considered. Based on these criteria, the Web of Science (WoS) database was chosen (Gürler, 2022).

Within the scope of bibliometric analysis, citation analysis, co-citation analysis, bibliometric coupling, and co-occurrence analysis were conducted. No filtering was applied between categories to determine trends and tendencies in the literature on University-Based Incubation Centers in WoS. Taking all categories into account, it was observed that a total of 165 publications were made between 2000 and 2024 as of March 27, 2024.

The evaluation of publications on university-based incubation centers obtained from WoS was conducted using bibliometric analysis methods. Publication information obtained from WoS was analyzed using bibliometric analysis techniques, including citation analysis, co-citation analysis, bibliometric coupling, and co-occurrence analysis.

In order to observe the literature on university-based incubation centers in the study, a search was first conducted based on keywords, subjects, titles, and abstracts. As seen in Figure 2 (a) and (b), it was determined that the concept was studied in 165 publications across different disciplines.

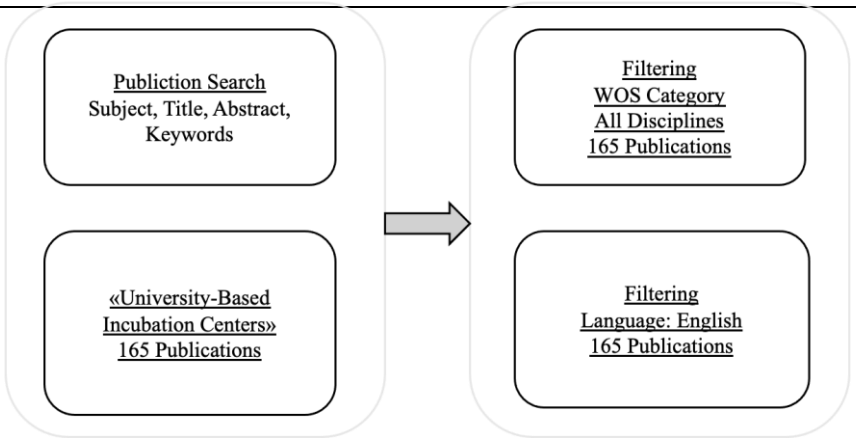

Figure 1. Research Flow Diagram

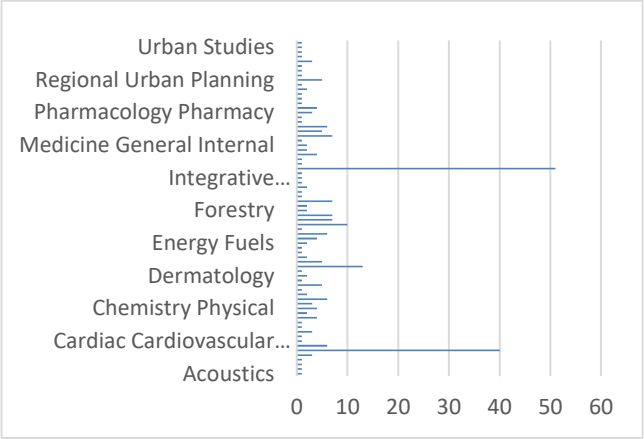

Figure 2 (a). Categorical Distribution of Publications in University-Based Incubation Centers Literature

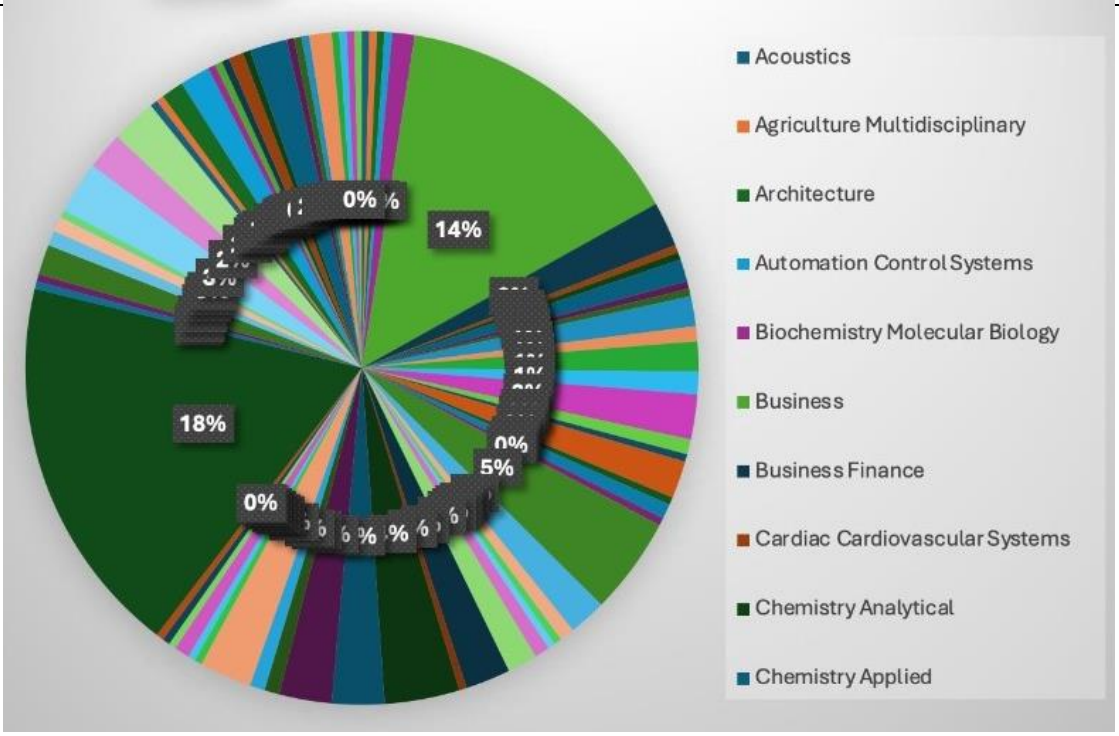

Figure 2 (b). Categorical (%) Distribution of Publications in University-Based Incubation Centers Literature

Figure 2 (a) and (b) indicate that university-based incubation center is an evolving concept in various disciplines, including business, business finance, and industrial engineering. However, to understand how the concept has evolved across all disciplines, no narrowing down has been applied to the categories. In this context, to observe the development trend of literature on university-based incubation centers across all disciplines, the study utilizes VOSviewer 1.6.16 software to conduct bibliometric analysis methods such as citation analysis, co-citation analysis, and co-occurrence analysis, and the findings of the research are presented.

3.1. Findings Related to the Research (RQ1, RQ2)

In the Web of Science (WOS) database, publications related to "University-Based Incubation Centers" are observed. Filtering was not applied to see how the concept of university-based incubation center is trending in the literature across all categories in WOS. As a result, 134 articles, 24 proceeding papers, 8 reviews, and 4 early access studies on University-Based Incubation Center were identified, totaling 170 studies. The distribution of these studies in WOS is shown in Figure 3.

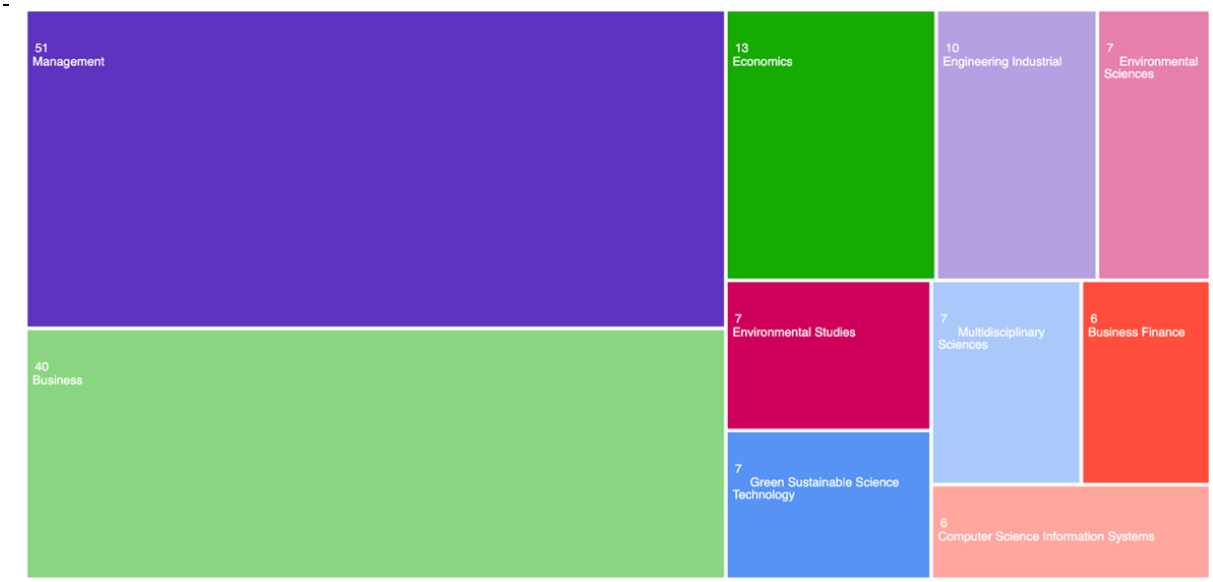

Figure 3. Distribution of Publications Related to University-Based Incubation Centers

During the querying stage of the University-Based Incubation Centers studies in WOS, it is observed that there are 170 publications related to the field of university-based incubation centers across all categories. Since all categories were considered in the study, disciplines ranging from water resources to ecology and multidisciplinary science were included. It is noted that 51 studies focusing on university-based incubation center in the fields of management, leadership, strategic management, human resources management, operations management, marketing management, financial management, information technology management, and entrepreneurship were published in the "Management" journal. Additionally, 6 studies focusing on university-based incubation centers in the field of computer science and information systems were published in the "Computer Science Information System" journal.

The "Computer Science Information System" journal primarily focuses on technology-oriented topics such as Data Mining, Data Analytics, Artificial Intelligence, and Machine Learning. However, in recent years, the contributions of universities to entrepreneurship and technology have also become notable. The increasing importance of university-based incubation centers has led to diversification in research in this field. Nowadays, it has become inevitable for universities to focus on commercializing technology-based ideas through collaboration with the business world. Therefore, leveraging the experiences and knowledge accumulated by universities in this area is crucial.

As shown in Figure 3, it is evident that publications in the management and business fields largely dominate the relevant literature. To observe the trend of publications over the years, Table 1 presents the data obtained from WoS. Compared to journals covering other topics, the publication rate of the "Computer Science Information System" journal in this field is relatively low, yet promising.

To understand the trend of studies related to University-Based Incubation Centers, the distribution of citation numbers over the years is depicted in Figure 4.

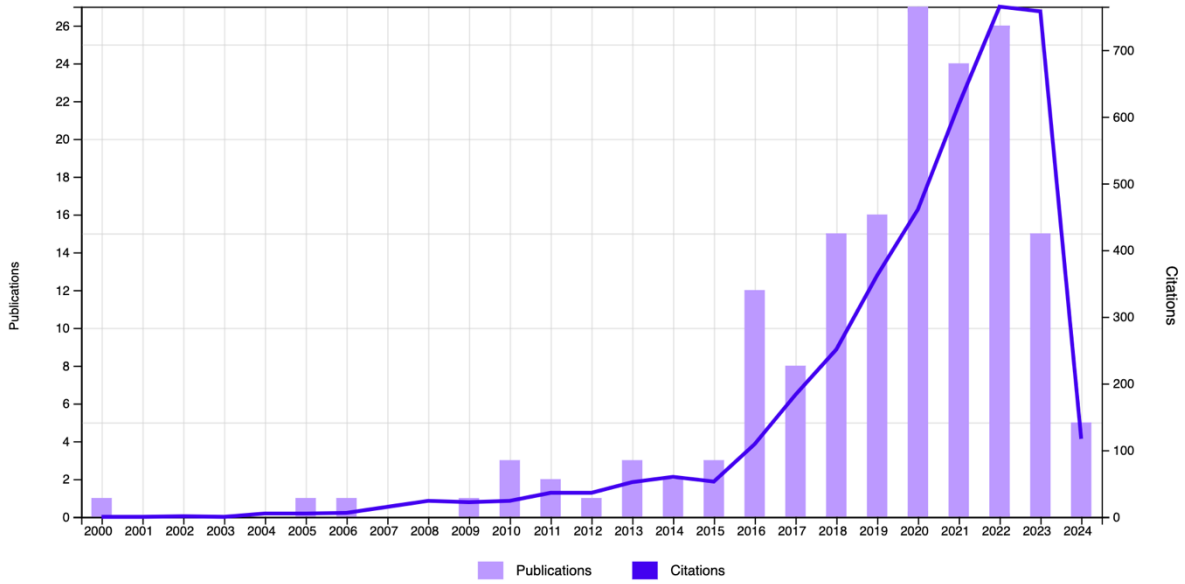

Figure 4. Citation Distribution for Studies on University-Based Incubation Centers

Reference: (Web of Science (WOS), March 29, 2024).

https://a8f59890210bb2a36cc265c34c80a801c14e01d5.vetisonline.com/wos/woscc/citation-report/fa2722c3-07ec-4a89-8540-d58053236013-da692e42?page=1&sort=sort-group-background-citingcount

Figure 4 provides the citation distribution of publications related to university-based incubation centers in WOS over the years across all disciplines. When examining the citation and publication distribution between 2000 and 2024, it is observed that there was a noticeable increase in both publications and citations, particularly starting from 2009. However, while there is an increase in citations between 2016, 2020, 2021, and 2022, it is noteworthy that there is not a significant increase in the number of publications during the same period. Especially, the dramatic increase in citations in 2022 and the reasons behind the increase in citations between 2020 and 2022, which follow a similar growth rate in publications, need to be further investigated through co-citation analyses to understand the reasons behind these trends.

3.1.1. Findings on citation analysis and co-citation networks (RQ3)

Breaks in publication and citation increases between 2019 and 2022 regarding university-based incubation centers are highlighted in Figure 2. In order to identify publications that could cause these breaks, Table 1 provides information on authors, publications, and citations.

Table 1. Distribution of Publications and Citations on University-Based Incubation Centers Between 2020-2024 Years

Authors	Publication	Citations					Total
		2020	2021	2022	2023	2024	
Markman, GD; Phan, PH; (...); Gianiodis, PT (2005)	Entrepreneurship and university-based technology transfer	26	24	13	22	77	347
Kohler,T (2016)	Corporate accelerators: Building bridges between corporations and startups	28	29	28	28	5	165
Spender, JC; Corvello, V; (...); Rippa, P (2017)	Startups and open innovation: a review of the literature	28	24	27	41	6	161
Phan, PH and Siegel, DS (2006)	The Effectiveness of University Technology Transfer	18	18	4	5	3	148
Cohen, S; Fehder, DC; (...); Murray, F (2019)	The design of startup accelerators	11	32	50	36	11	141
van Weele, M; van Rijnsoever, FJ and Nauta, F (2017)	You can't always get what you want: How entrepreneur's perceived resource needs affect the incubator's assertiveness	15	11	22	9	1	78
van Rijnsoever, FJ (2020)	Meeting, mating, and intermediating: How incubators can overcome weak network problems in entrepreneurial ecosystems	12	17	22	20	2	73
Di Pietro, F; Prencipe, A and Majchrzak, A (2018)	Crowd Equity Investors: AN UNDERUTILIZED ASSET FOR OPEN INNOVATION IN STARTUPS	12	16	14	11	3	65
Stayton, J and Mangematin, V (2019)	Seed accelerators and the speed of new venture creation	10	9	18	12	1	51
Sansone, G; Andreotti, P; (...); Landoni, P (2020)	Are social incubators different from other incubators? Evidence from Italy	5	13	14	18	0	50
Surana, K; Singh, A and Sagar, AD (2020)	Strengthening science, technology, and innovation-based incubators to help achieve Sustainable Development Goals: Lessons from India	2	7	16	21	3	49
Yin, BQ and Luo, JX (2018)	How Do Accelerators Select Startups? Shifting Decision Criteria Across Stages	4	7	20	6	3	40

As seen in Table 1, the studies with the highest citations in the relevant field are respectively Markman (2005), Kohler (2016), and Spender (2017). This observation is further supported by Figure 5, which presents the publications citing university-based incubation centers between 2018 and 2024.

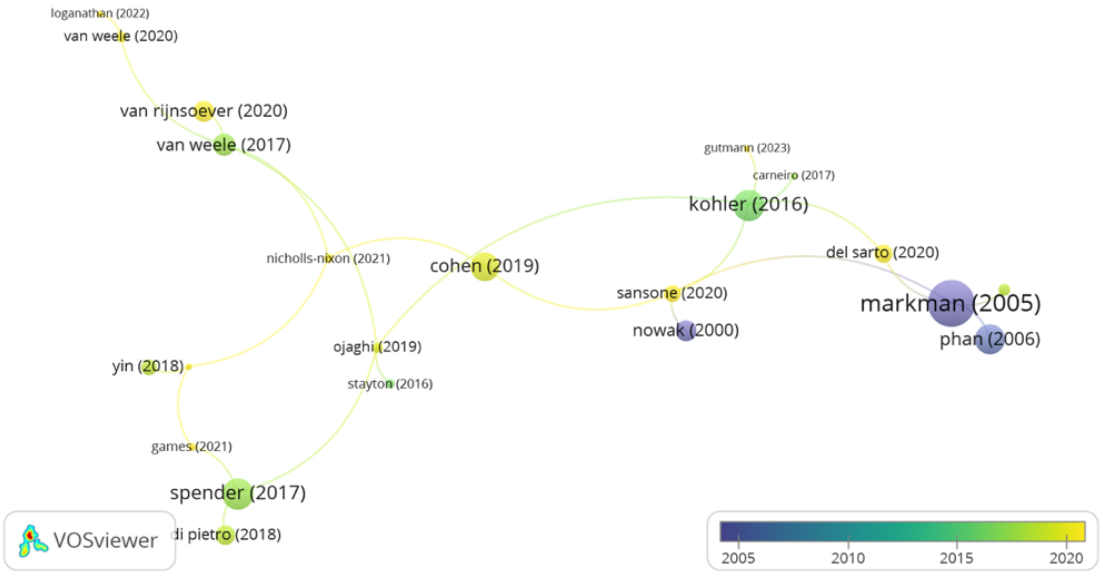

Figure 5. Bibliometric Matching of Studies on University-Based Incubation Centers in the Entrepreneurship Ecosystem

In Figure 5, references to other studies related to Markman (2005), Kohler (2016), and Spender (2017) are

provided. The main reason for universities to act as an economic driving force in the development of startups and the commercialization of ideas is highlighted. Clark (2001) defines universities as institutions with unique genetic characteristics and developmental trajectories predicted by their general tendencies and social commitments. Rosan (2006) expresses universities as indispensable elements in increasing knowledge levels within society and raising living standards by stimulating increased production of goods and services as a result of economic development. Consequently, with the transformation and change experienced across all sectors of society starting from the Industrial Revolution, the role of universities has expanded. It directly influences the success of startups when universities, acknowledged as technology providers (Guerrero and Urbano, 2012), effectively transfer technology to entrepreneurs. In this context, it can be considered that Markman (2005) extensively addresses the reasons underlying the success of university-based incubation centers and technology parks, while Kohler (2016) discusses corporate innovation to reshape the business models of startups, focusing on internal innovation to enable companies to capture agility by shedding inertia over time. Additionally, Spender (2017) is presumed to examine the role of startups in open innovation processes and conduct a literature review in this area.

3.1.2. Findings regarding co-occurrence analysis and co-occurrence networks (RQ4)

Detection of focal points in studies related to university-based incubation centers can be observed through citation and publication analyses. Figure 6 displays the clusters of studies obtained from the co-occurrence analysis of all 165 studies on university-based incubation centers in various categories in WOS.

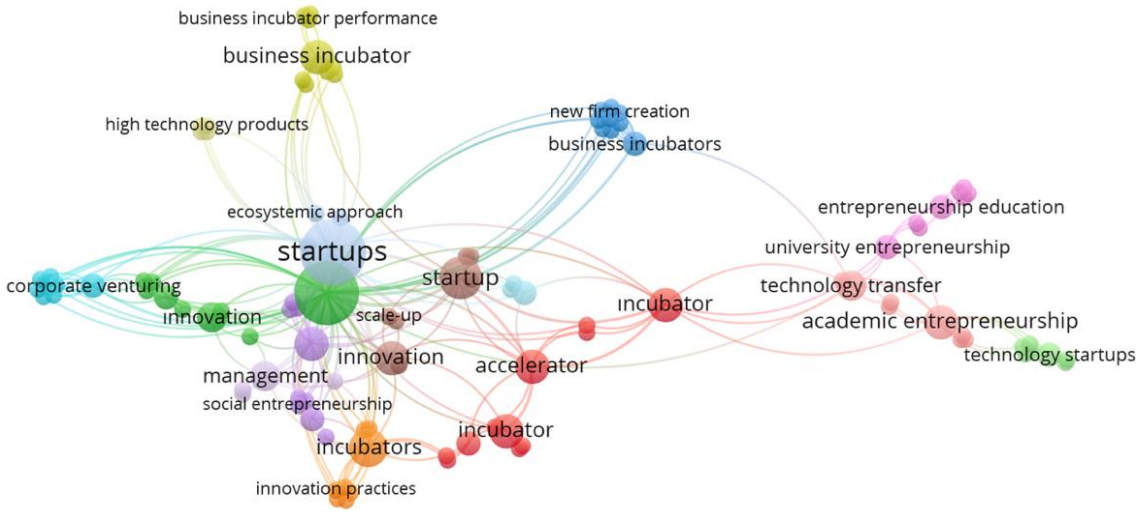

Figure 6. Co-occurrence Analysis of University-Based Incubation Centers

As indicated in Figure 6, the focal points of the studies related to university-based incubation centers include

entrepreneurship, startups, business incubator, and new firm creation concepts. According to the co-occurrence analysis of publications in WOS, although an attempt was made to create a study cluster related to the concept, the concepts within each color scale have not been clustered due to their interaction with the concepts in the other color scales and their interchangeable nature, but evaluated based on colors. In this context, 5 color scales stand out in Figure 6.

As depicted in Figure 6, the red color scale, focusing on accelerating the commercialization and scaling of an idea; the blue cluster scale, focusing on the interaction of corporate entrepreneurship with internal company performance; the purple cluster scale, similar to the purple cluster, focusing on incubation centers, incubation center management, and incubation center strategy, preparing the ground for the development and growth of ventures; the yellow cluster scale, focusing on the impact and performance of the incubation center, and successfully commercializing the processes of an idea; the green cluster scale, focusing on innovations and the role of accelerators in ventures, by centralizing ventures that have reached a certain stage, stands out.

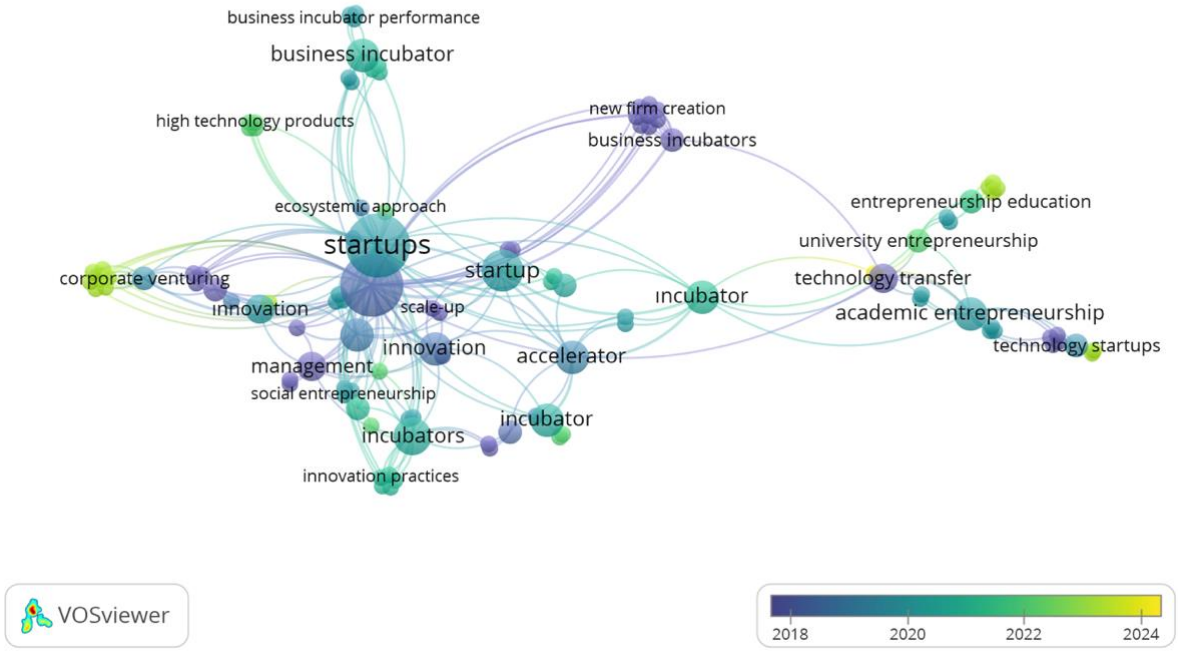

Figure 7. Co-Occurrence Analysis of University-Based Incubation Centers

As shown in Figure 7, a visual representation of co-occurrence analysis of publications related to university-based incubation centers in the Web of Science (WOS) is presented. This analysis is based on the high-scoring studies in terms of citation, interconnectedness, and bibliographic similarity. The evaluation encompasses the concepts found in WOS publications between 2018 and 2024. In 2018, publications associated with entrepreneurship, firm growth, management, technology transfer, scale-up, and business incubators are prevalent. Towards the end of 2018 and the beginning of 2020, there is a focus on startups, incubators, business

incubator, and business incubator performance. In 2022, the interaction between startup, incubator, accelerator, and academic entrepreneurship is emphasized. From late 2022 to the present, the literature predominantly explores the relationship between entrepreneurship and startups, with a focus on university-based incubation centers, entrepreneurship education, and ventures. To better understand the distinct patterns in these developments, a point-by-point evaluation based on years regarding university-based incubation centers could be beneficial. In other words, analyzing the networks individually through co-occurrence analyses, as depicted in Figure 8 (a), (b), and (c), would be necessary.

As emphasized in Figure 7 and Figure 8, the literature intersecting startups, incubators, and accelerators in 2020 indicates a structuring focus. Particularly within the entrepreneurship ecosystem, there is a noticeable academic interest in entities such as incubators, accelerators, and venture capital that play significant roles in the realization of ideas. These concepts are regarded as facilitating entrepreneurship processes and contributing to the successful survival of ventures.

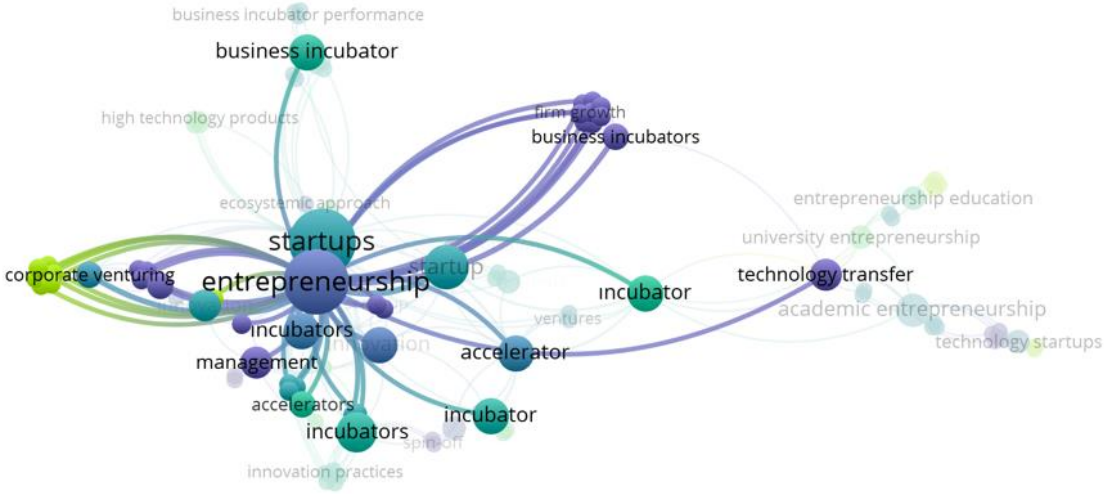

Figure 8 (a). Co-Occurrence Analysis of Entrepreneurship-Oriented Studies

In Figure 8a, it can be observed that the concepts of business incubator, incubators, and technology transfer intersect within the entrepreneurship domain. Additionally, concepts such as firm growth and management, which are associated with entrepreneurship, are also within the entrepreneurship cluster but appear to be at a greater distance.

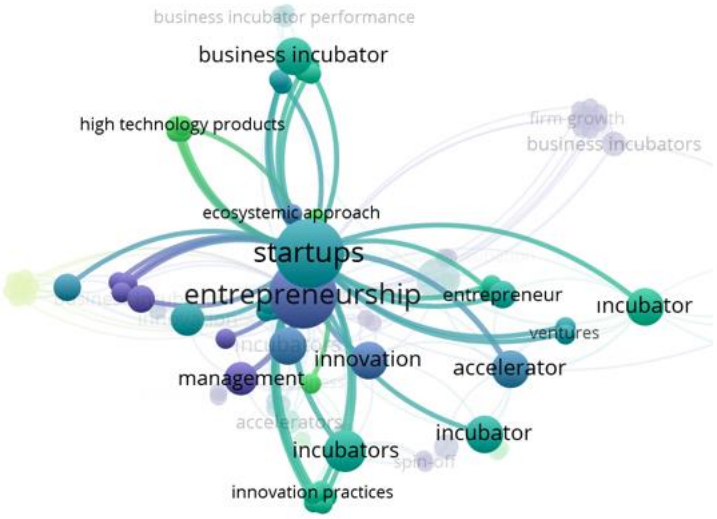

Figure 8 (b). Co-Occurrence Analysis of Startups and Business Incubator Oriented Studies

In Figure 8b, startups are positioned at the center of the cluster, with the intersecting concepts of incubators and business incubator, which play a crucial role in the development of startups. It can be observed that the concepts presented here are interrelated with each other.

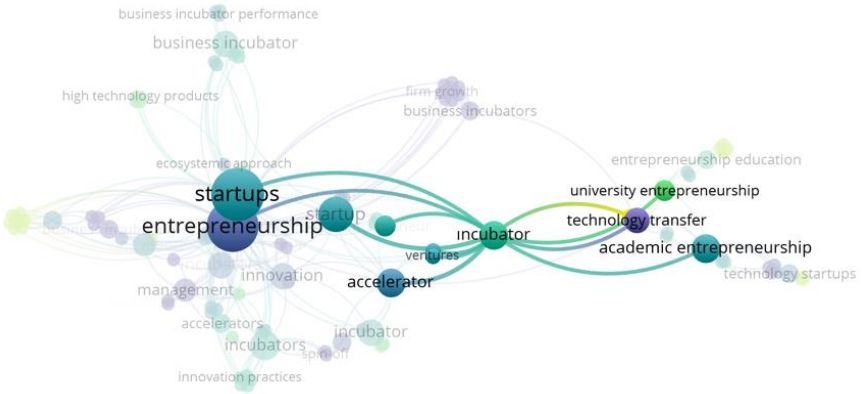

Figure 8 (c). Co-Occurrence Analysis of Incubator-Oriented Studies

In Figure 8c, it is observed that at the intersection of the entrepreneurship and startup clusters, the center is occupied by the concept of incubator, and the incubator concept is equally related to both startups and entrepreneurship, as well as university-based incubation centers and technology transfer, indicating mutual reinforcement among these concepts.

To observe the distribution of publications contributing to conceptual linkages in the literature of university-based incubation centers at the country level, Figure 9 presents a co-occurrence analysis of countries related to university-based incubation centers.

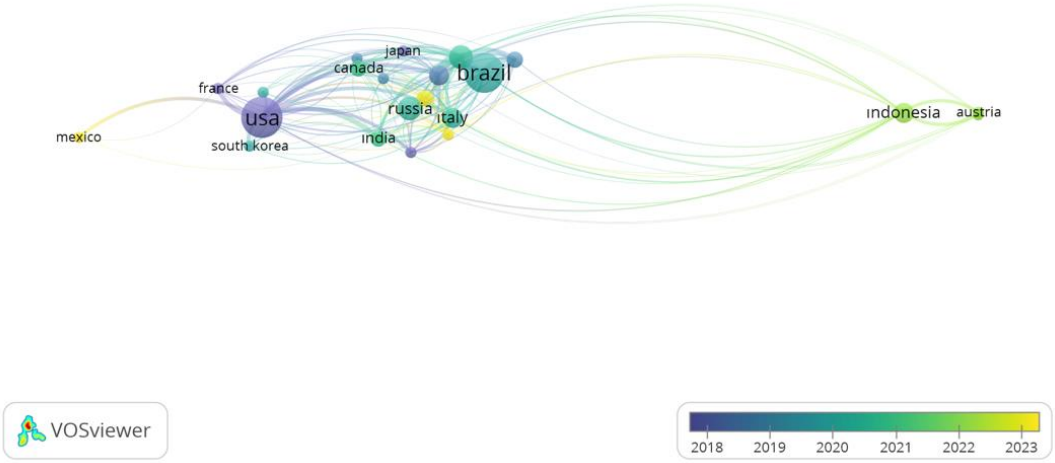

Figure 9. Co-occurrence Analysis of Countries Related to University-Based Incubation Centers

In recent years, there has been a notable increase in academic interest in university-based incubation centers. Particularly in 2020, 2021, and 2022, this increase has become more pronounced compared to previous years, as visually confirmed through various figures and tables. For instance, while publications in 2018 primarily originated from countries with advanced capital markets such as the United States, Japan, France, and Singapore, from 2020 onwards, these publications shifted towards emerging economies like Brazil, Italy, Spain, and Russia. Contributions from countries such as Austria, Indonesia, and Saudi Arabia were observed between 2022 and 2024, indicating a dynamic shift influenced by dynamic business environments and opportunities presented by developing economies.

The literature on university-based incubation centers is extensively documented in major databases such as Web of Science (WOS), focusing on publications in management and business disciplines. Bibliometric studies have deeply analyzed the publication history and academic impact of these centers, presenting collaboration networks and citation data. The results of these studies emphasize the scientific significance and impact of university-based incubation centers. For example, pioneering work by Markman (2005) extensively describes the success factors of these centers and the new opportunities they offer for entrepreneurs.

Developing economies offer increased opportunities for new ventures and innovation, attracting entrepreneurs and investors alike. University-based incubation centers have become a crucial part of this ecosystem by providing entrepreneurs access to necessary resources and support.

Dynamic and evolving business environments tend to be more receptive to innovation and new ideas, thereby

increasing interest in the programs and services offered by university-based incubation centers. Advanced capital markets facilitate easier access to finance for ventures, contributing to the development of entrepreneurship. University-based incubation centers can facilitate this process by connecting entrepreneurs with investors.

Publications on university-based incubation centers encompass a wide range of disciplines in management journals. This interdisciplinary approach helps us understand their operations and evaluate their socio-economic impacts. Literature covers various disciplines such as management, leadership, strategic management, human resources management, operations management, marketing management, financial management, information technology management, and entrepreneurship, addressing contributions of these centers.

However, there are significant gaps in research on university-based incubation centers that need attention. Particularly, there is a need for comparative analyses of these centers across different countries and investigations into their long-term impacts. Additionally, more qualitative research is needed on the internal operations of university-based incubation centers and their effects on entrepreneurs. Research on the long-term effects and sustainability of university-based incubation centers is also necessary. Furthermore, the potential disadvantages and limitations of these centers should be critically examined.

In conclusion, university-based incubation centers emerge as significant tools for promoting entrepreneurship and fostering innovation. The increasing interest in these centers in recent years underscores the need for further development in research and practices in this field.

Future research can offer new perspectives by conducting more in-depth studies on how these centers operate in different geographical contexts, their impact on developing economies, and their long-term sustainability. Additionally, critical examination of the potential disadvantages and limitations of these centers is essential.
Moreover, to observe developments in the university-based incubation center literature, a bibliometric study was conducted using publications in the fields of management and business available in WOS, focusing on collaboration networks and citation analyses. Evaluations of research findings will be discussed in detail in the conclusion section.

4. CONCLUSION

University-based incubation centers present an important conceptual framework at the intersection of entrepreneurship, accelerators, and incubators. In our study, a bibliometric analysis was conducted based on 165 publications across all disciplines in the Web of Science database. The limitation of this study lies in its reliance on publications up to March 2024, with limited data available for 2024. The analysis of relevant studies reveals an increasing interest in the concept of university-based incubation centers between 2020 and 2022. These centers play a critical role in the development of the entrepreneurial ecosystem.

The level of economic development of a country is directly proportional to the level of development of its

entrepreneurial ecosystem. Particularly, the transition of the United States from an industrial society to an information society, and the rapid spread of this transformation to European countries, has made support structures such as incubation centers necessary for the survival of enterprises, which form the backbone of developed economies. The increasing demand in entrepreneurship and innovation fields has heightened interest in incubation centers that act as bridges from the idea stage to the commercialization stage.

In the late 2010s, rapid technological advancement significantly contributed to the transformation of universities into entrepreneurial universities and underscored the role of university-based incubation centers. An analysis of publications and citations related to university-based incubation centers across countries shows that in 2018, publications were particularly concentrated in the United States, which aligns with state policies and incentives aimed at developing the entrepreneurial ecosystem. However, between 2020 and 2021, there was a shift towards developing economies where entrepreneurship began to emerge more prominently. Regarding digital entrepreneurship, the distribution of publications and citations across countries indicates a concentration in Germany in 2019, driven by state policies and incentives leading the way in digitalization and technological advancements. However, from 2020 to 2021, there was a transition towards countries that adapted to technological advancements later but encouraged the establishment of entrepreneurship centers and were open to technological investments. A rapidly evolving literature, especially with significant progress in the ecosystem approach from 2018, has been observed. The increasing interest in accelerator-incubator interactions, startup-incubator relationships, and university-based incubation centers between 2018 and 2020 indicates a rapid development of the concept.

In this context, university-based incubation centers in different countries can be examined. For example, in the United States, the Stanford Incubation Center, MIT Entrepreneurship Lab, and Berkeley Entrepreneurship Center stand out. Projects such as Google, which started at Stanford, showcase the impact of these centers. The MIT Entrepreneurship Lab has produced many successful ventures that have secured significant positions in the tech world. The Berkeley Entrepreneurship Center offers extensive support to students and researchers, facilitating the commercialization of innovative ideas.

In Europe, the European Entrepreneurship Center (Brussels), the Cambridge Incubation Center (United Kingdom), and the Munich Entrepreneurship Center (Germany) are prominent. The Brussels center provides robust support to entrepreneurs across the continent. The Cambridge Incubation Center has fostered strong ventures, particularly in biotechnology and information technology. The Munich Entrepreneurship Center enhances Germany's leadership in digitalization and technological advancements. Significant examples are also found in developing economies. The INSEAD Entrepreneurship Center in Singapore serves as a key entrepreneurial hub in Asia, producing globally successful ventures. The Kadir Has University Incubation Center in Turkey supports local and regional entrepreneurs. The Ashoka Incubation Center in India promotes social entrepreneurship, offering innovative solutions to social problems. Successful entrepreneurial stories highlight the tangible contributions of university-based incubation centers. For instance, Google, which began at Stanford

University, has grown into one of the largest technology companies globally. Dropbox, emerging from the MIT Entrepreneurship Lab, provides a widely used file storage service worldwide. DeepMind, founded at Cambridge University, achieved significant success after being acquired by Google.

Policy recommendations to enhance the effectiveness of university-based incubation centers are crucial. Increasing government financial support, strengthening physical and digital infrastructure, and developing mentorship and training programs provided by experienced entrepreneurs and business leaders are key areas for improvement. These recommendations can help incubation centers reach more entrepreneurs and enhance their knowledge and skills. Conducting a comparative analysis of university-based incubation centers across different countries or types can provide valuable insights into their effectiveness. For example, examining the differences and similarities between incubation centers in the United States and Europe can be illuminating. Analyzing the distinctions between incubation centers in developed and developing economies, in terms of government support, infrastructure, and entrepreneurial culture, can help identify effective models and approaches.

Finally, collecting primary data through surveys or interviews with entrepreneurs and managers who use university-based incubation centers can offer valuable insights into their perceptions and effectiveness. Surveys and interviews can enhance the robustness and reliability of your study. These practical examples and recommendations will increase the practical contribution of your study and improve its chances of being published in a peer-reviewed journal.

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