

Tıbbi Yapay Zeka Çözümleri



Ahmet Karagöz

Machine Learning Engineer

Özgeçmiş

- HeviAI (Ocak 2021 - Günümüz)
- İstanbul Teknik Üni. (Haziran 2022 – 2023 Ağustos)
- Boğaziçi Üni. – BMEI (2019 –Ocak 2022)
- Yeşil Science (6 ay - 2020)
- Yeditepe Uni. – MIL (14 ay - 2017- 2018)
- TÜBİTAK UME (3+10 ay - 2017)
- UPC - Erasmus (5 ay - 2016)



Founding Team



Deniz Aliş

CEO

Associate Professor
of Radiology

Cerrahpasa & Acibadem University
+10 Years Healthcare Experience
+70 Peer-Reviewed Publications



Mert Çelenk

CTO

Electric and
Electronic Engineer

Ex Turkcell and Vodafone
+10 years software development
experience



Mert Yergin

Chief AI Scientist

Computer Engineer

+5 years computer vision experience
Significant Expertise in DL for Medical
Imaging
Google Developer



Erdem Yaman

Solution Architect
Computer Engineer

Ex Siemens
+12 years software development
experience

Team



AHMET KARAGÖZ
Machine Learning
Engineer



HASAN AQA
Software Engineer



ONURCAN ŞAHAN
Machine Learning
Engineer



ALANUR SAVAŞ
Product Owner



ATA DANEYEMEZ
Head of Sales



SAİD KARTAL
Machine Learning
Engineer



BEYZA ERBAŞ
Sales&Marketing
Manager



AYHAN YÜKSEK
Software Engineer



MELİH ÇELENK
Software Engineer



ESLEM ÖZKUL
Project Manager



EDA AYDIN
Machine Learning
Engineer



ENES POLAT
IT Specialist

Advisory Board



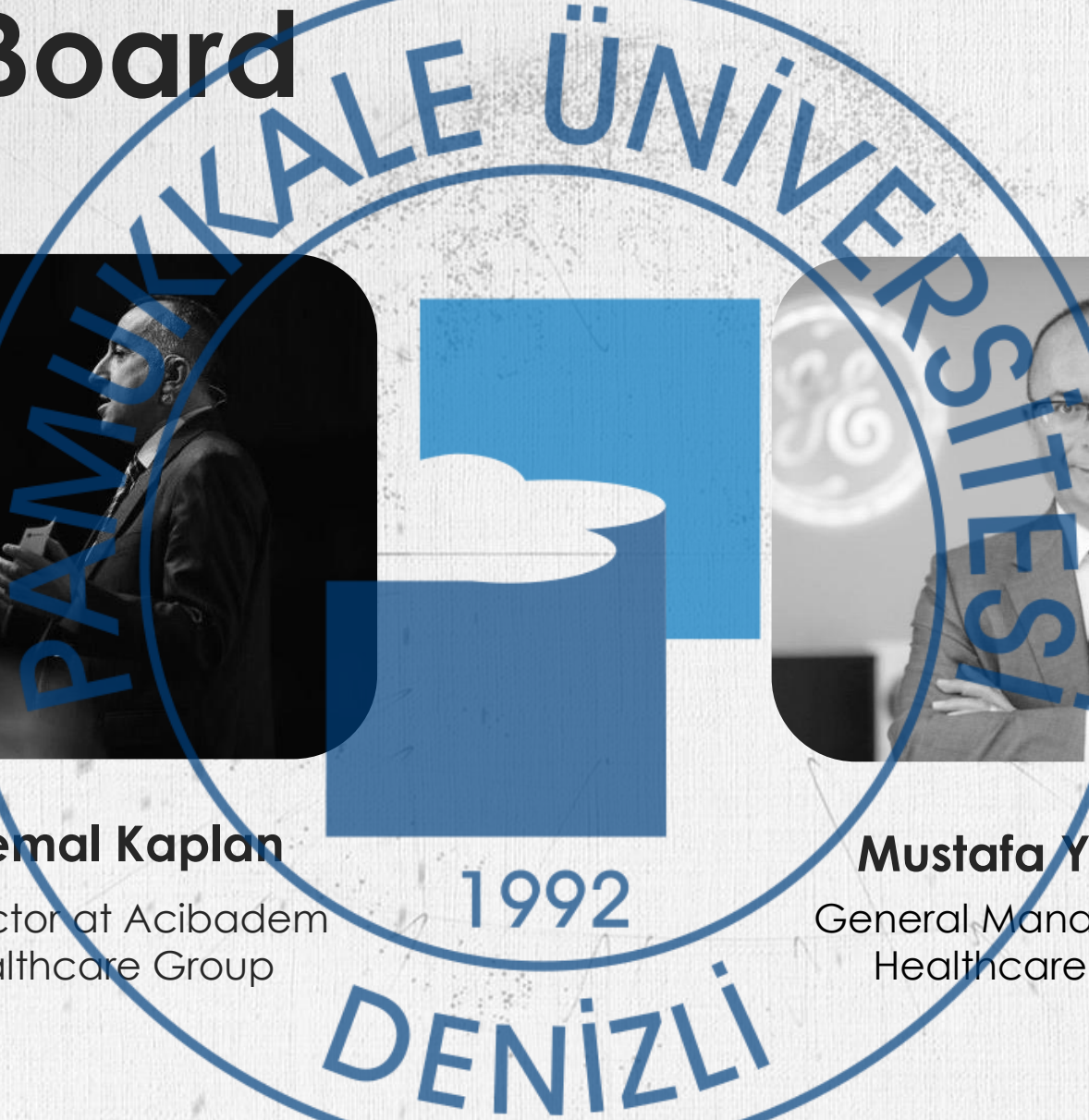
Kemal Kaplan

IT Director at Acibadem
Healthcare Group



Mustafa Yıldırım

General Manager at GE
Healthcare Turkey



Advisory Board



Ilkay Oksuz

Associate Professor of
Computer Engineering
Istanbul Technical University



Ercan Karaarslan

Professor of Radiology
Head of Maslak and Atasehir
Acibadem Radiology Department



M. Hakkı Karakaş

Director of Medical
Imaging
Services of Istanbul Province



Clinical Team



DR. ÖMER BAĞCILAR



DR. AHMET ÜSTÜNDAĞ



DR. YEŞEREN ŞENLİ



DR. EMİL HİKMET



DR. EMİNE MELTEM



DR. ESMA TUFAN



DR. NURPER DENİZÖĞÜ



DR. CEMRE KAVİ



DR. YELİZ BAŞAR



DR. ENES DEĞER



DR. ERENCAN KARAKOÇ



DR. KASIM KARABULUT



DR. BATUHAN GÜRÖZ



DR. NURPER DENİZÖĞÜ

Academic Team



Prof. Dr. Ercan Karaarslan



Do Dr. İlkey Öksüz



Mustafa Ege Şeker



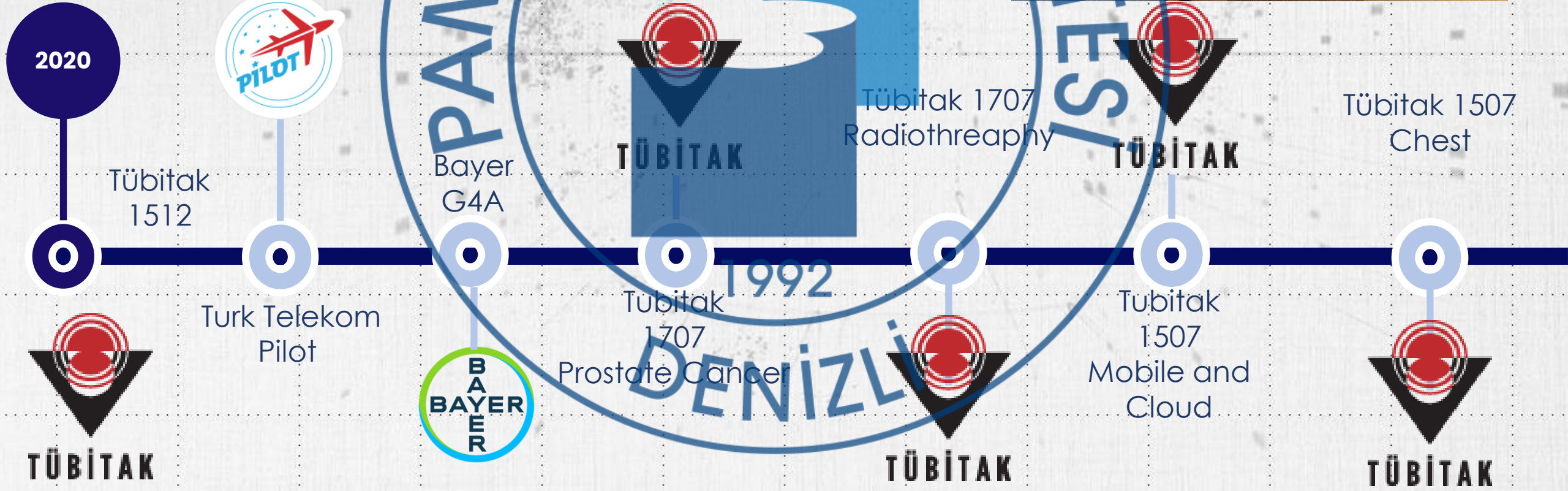
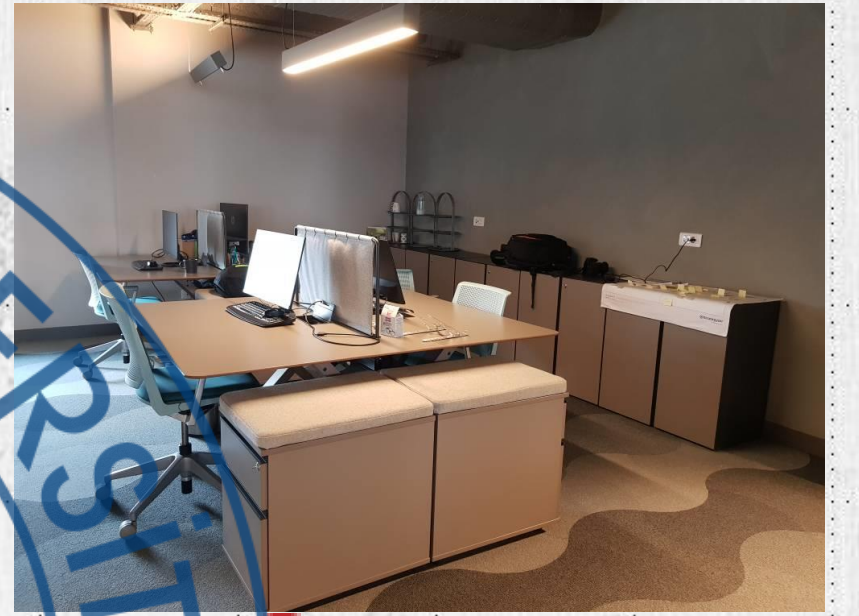
Delal Şeker



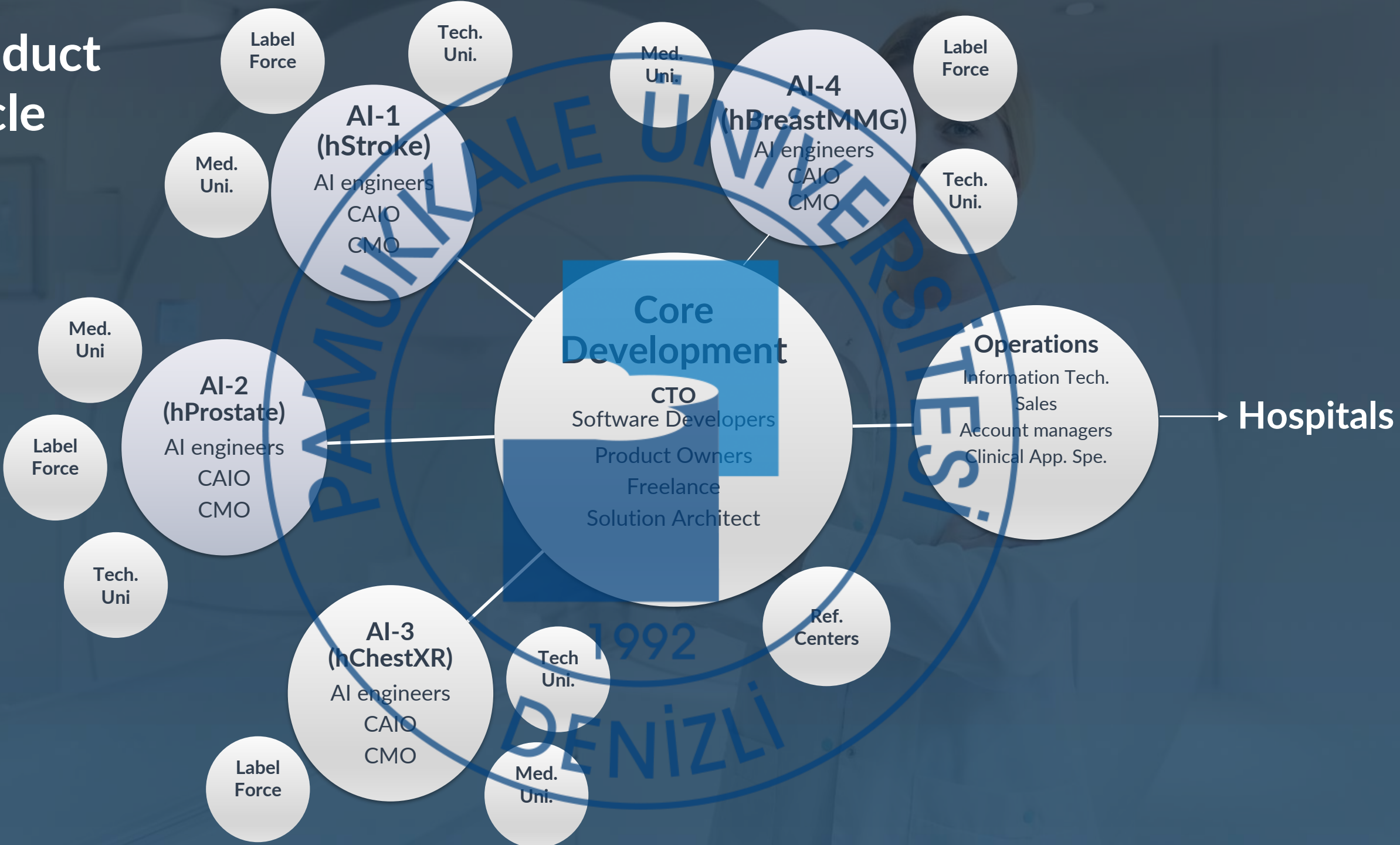
Osman Bayram

hevi ai

- Hızlı ve çevik
- Deneyimli ekip üyeleri
- Multidisipliner çalışma
- 16 tam zamanlı çalışan



Product Cycle



Gerekçe / İhtiyaç



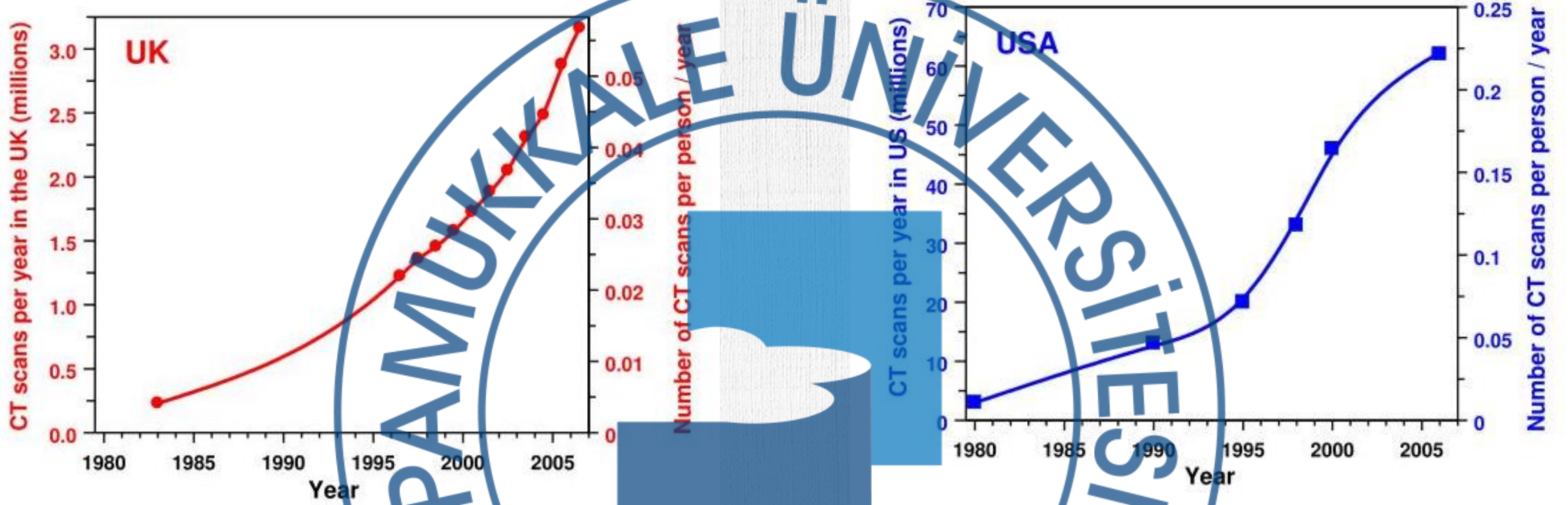
EKONOMİK



KLİNİK



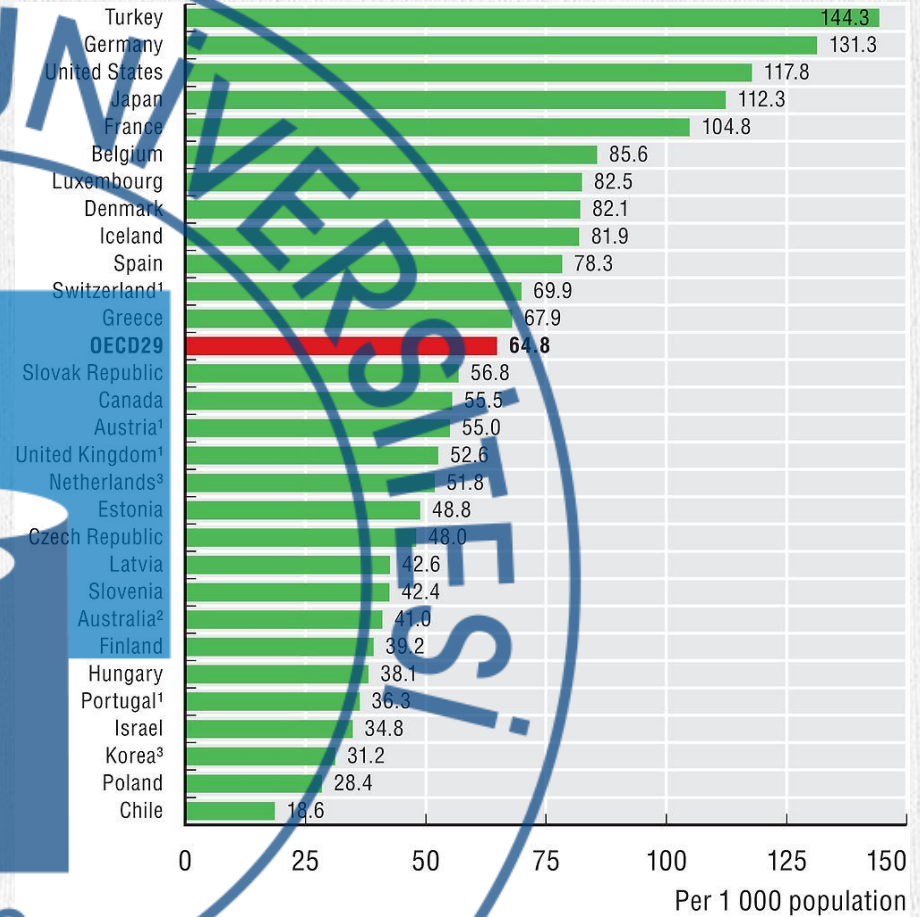
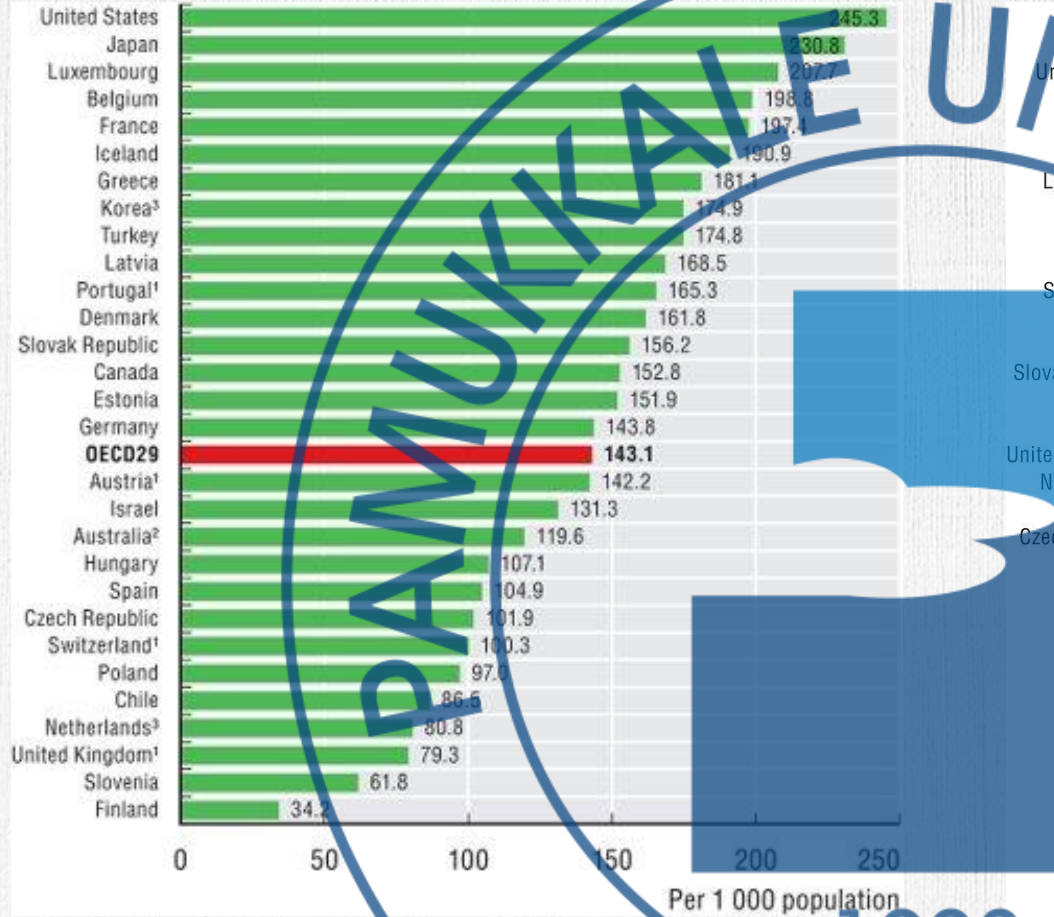
OPERASYONEL



Son yıllarda bilgisayarlı tomografi (BT) kullanımı hastalara tanı koyabilme açısından vazgeçilmez bir görüntüleme teknolojisi olduğu tüm otoritelerce kabul edilmekle birlikte **BT kullanımında aşırı bir artış** bulunmaktadır.

BT

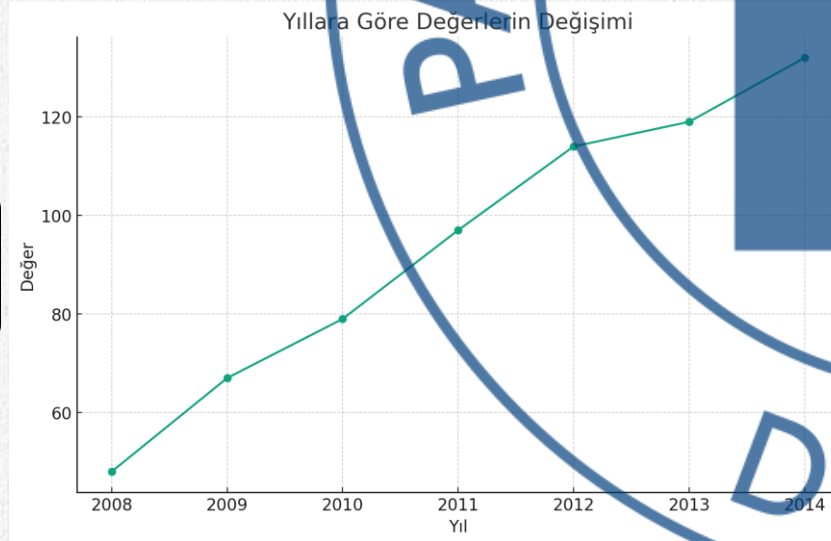
MR



Türkiyedeki BT / MR Çekim Sayıları

Türkiye'de Cihaz Fazlalığı Var Mı?

Yöntem	Türkiye	OECD
#MRG / 1M	10,2	15,9
#MRG inceleme / 1000	144	64
#BT / 1M	14,3	25,2
#BT inceleme / 1000	175	142



MR çekimlerinde %19 artış

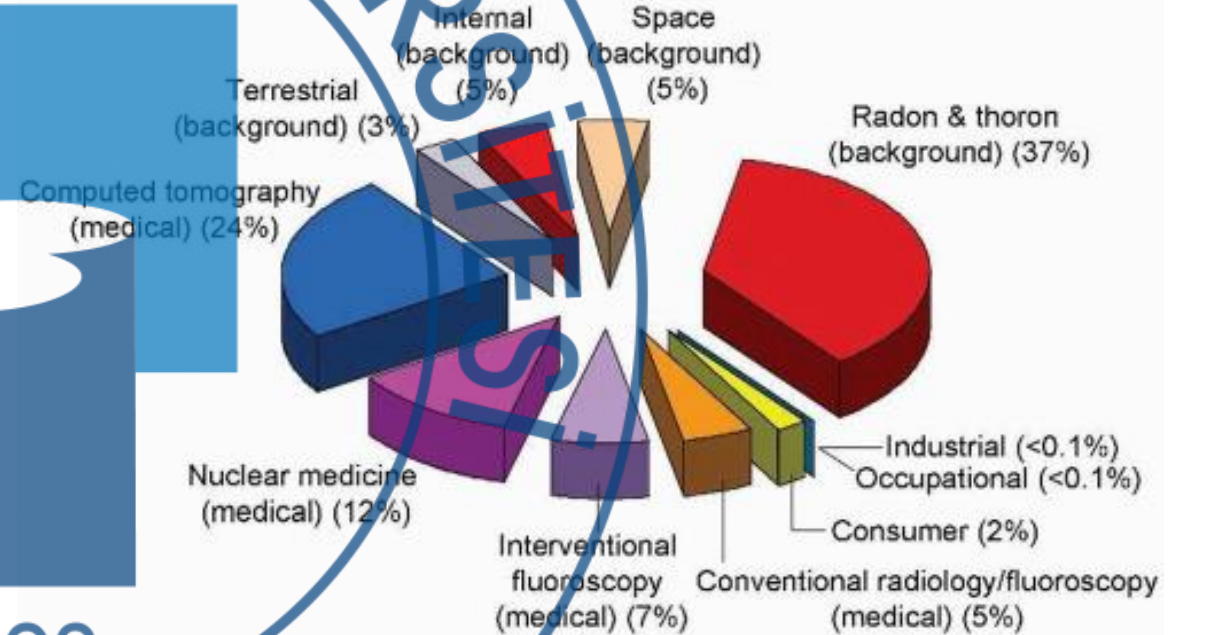
- Hızlı çekim
- Standardize olmayan çekim
- Yanlış doz

Aşırı çekim mevcut!

BT tetkiki bütün tıbbi tetkiklerden alınan yıllık **kollektif radyasyon dozunun %40'ından sorumludur.**

- Dünyada yapılan araştırmalarda **%7-60** arası gereksiz çekim bulunmakta.
- Yakın gelecekte tüm kanser vakalarının **%2'si** tanısal görüntüleme yüzünden olacak!

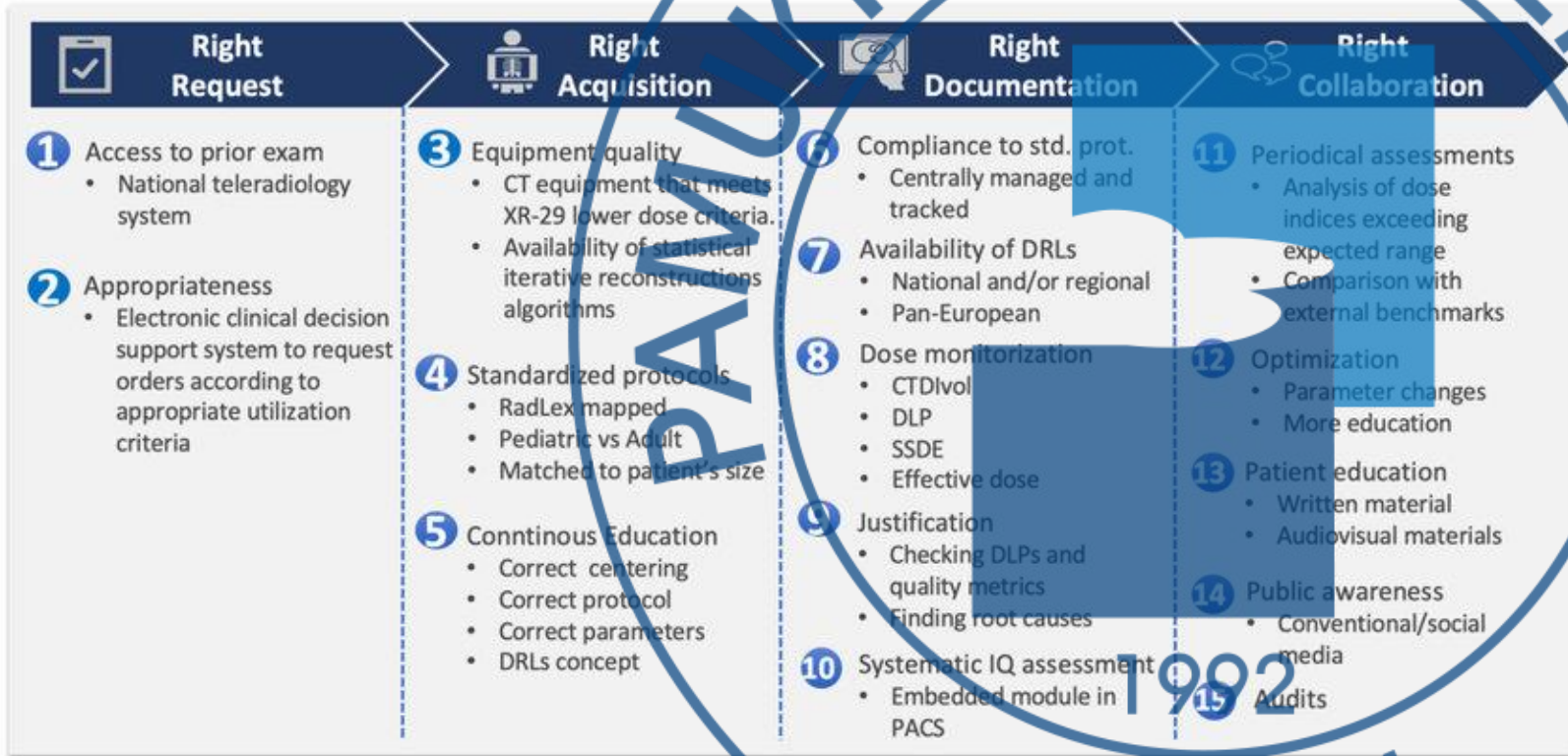
% Contribution of Sources of Exposures



1992

DENİZLİ

Neler yapılabilir?



• 15 adım var:

• Uygunluk

• Erişilebilirlik

• ...

Uygunluk

459 tane çekim incelenmiş: 284 (%62) CT, 175 (%38) MRI

- 341 tanesi doğru (%74)
- 118 tanesi uygun değil (%26) (örn. MR yerine CT çekimi istemi)

Eğer uygun çekilirse klinik sürece **%58** katkısı var

Uygun olmazsa **%24** katkı sağlıyor

- İngiltere'de yapılan bir çalışmada yanlış çekimin yatış süresini uzattığı ortaya konulmuş - gerçek hastalık yerine farklı hastalıkların tedavi edildiği ve maddi kayıp olduğu gözlenmiş.

Eriřilebilirlik

- Hastanın yakın zamandaki görüntülemelerinin gözden geçirilmesi
- Gereksiz çekimlerin önüne geçme



Türkiye'de yapılan uygunluk çalışması (2015) sonuçlarına göre;

%48 uygun
olmayan
çekim var

%43 farklı
çekim
yapılmalı

%5 hiç
çekilmemesi
gerekli

1992

DENİZLİ

Uluslararası Temel Güvenlik Standartları (IAEA-BSS)

- Hastanın radyasyondan korunması için 2 temel prensip var:
 - **Gerekçelendirme** (Uygun incelemeyi yap)
 - **Optimizasyon** (İncelemeyi uygun yap)
- Yönerge kitabı mevcut ancak çok uzun yönergelerin pratikte kullanımı zor
- Karar destek sistemi Amerika'da çok faydalı bulunmuş.



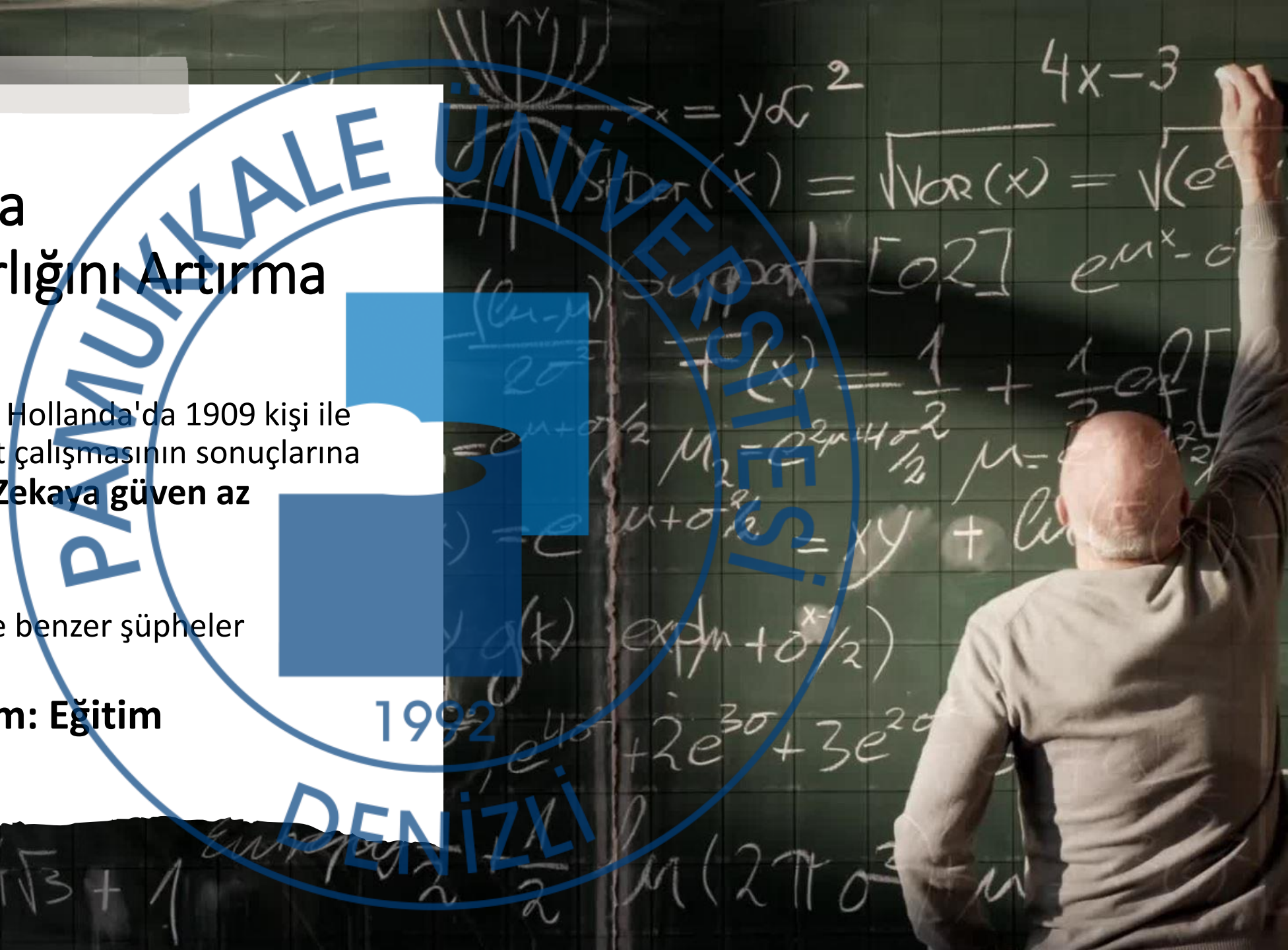
Verimliliği Artırmak için Devrimsel Yaklaşım:

- Yapay Zeka'nın yapabilecekleri ve yapamayacakları **iyi bilinmeli**
- Yapamayacaklarını yapabilir olarak anlatıp **yanlış bilgi vermemek** gerekli



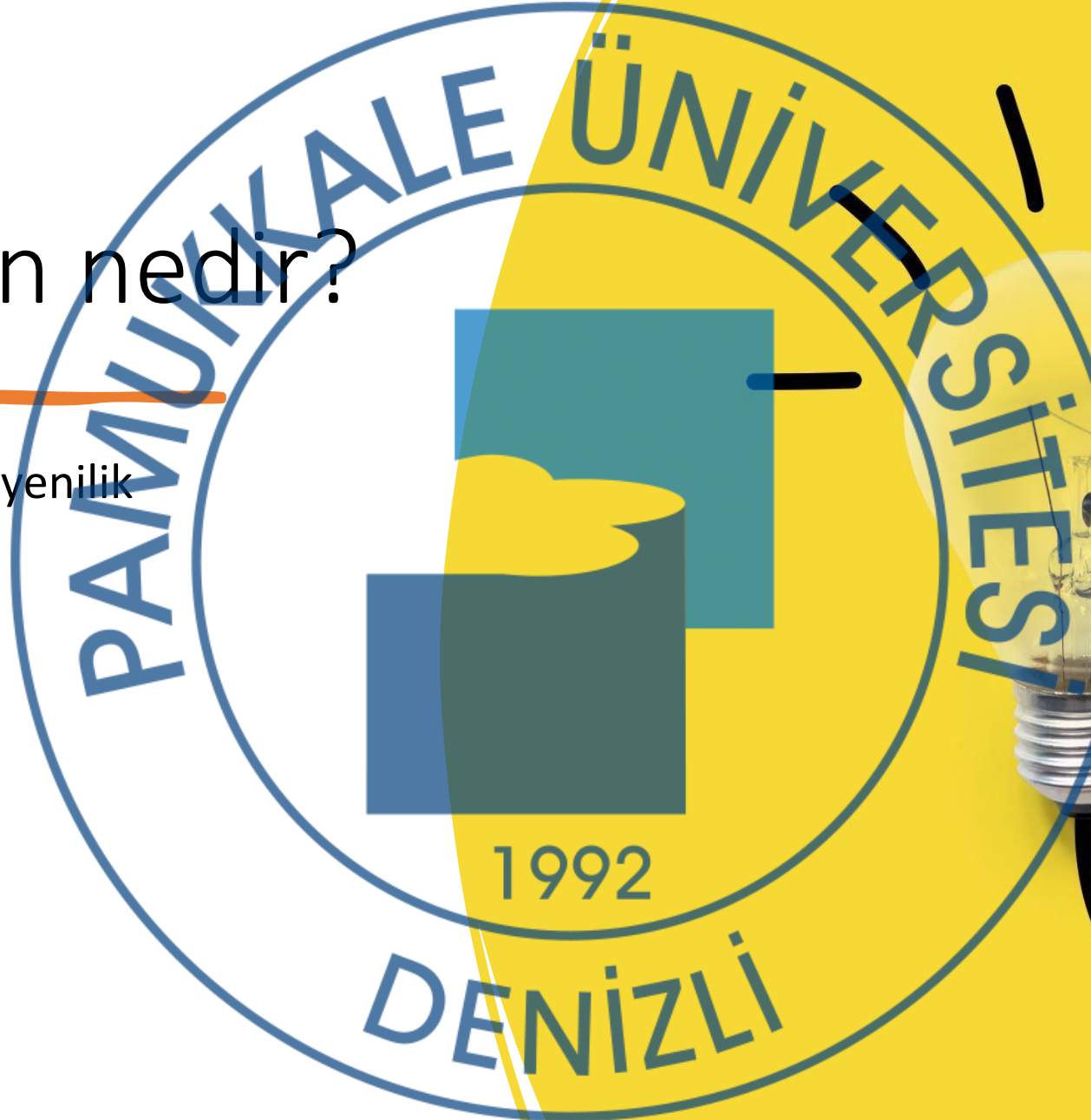
Yapay Zeka Okuryazarlığını Artırma

- Eylül 2021de Hollanda'da 1909 kişi ile yapılan anket çalışmasının sonuçlarına göre **Yapay Zekaya güven az** bulunmuş.
- Türkiye'de de benzer şüpheler bulunmakta.
 - **Çözüm: Eğitim**



İnovasyon nedir?

- Ticarileştirilebilir yenilik



Regülasyon?
İnovasyon?

Amerika ve Kıta Avrupasında
farklı yaklaşımlar bulunmaktadır

Sağlıkta İnovasyon ama
disruption değil

Hastanın zararına olacak
durumları **engelle**

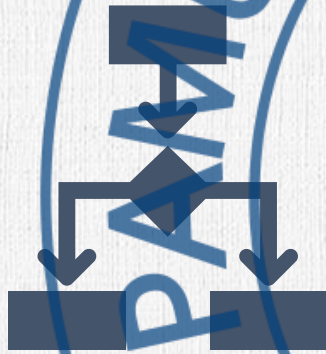
Yıkıcı Teknolojiler

Mevcut pazarları ve iş yapma
şekillerini temelden
değiştirebilecek yenilikçi
teknolojiler...

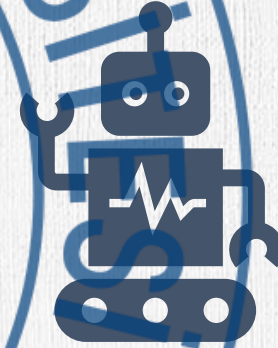


Zeka Nedir?

Yapay Zeka Nedir?



Zekâ zihnîn öğrenme, öğrenîlenden yararlanabilme, yeni durumlara uyabilme ve yeni çözüm yolları bulabilme yeteneğidir.



Yapay Zeka insan tarafından yapıldığında, doğal zekayı gerektiren görevleri yapabilecek mekanizmanın oluşturulması çabalarının tümü olarak değerlendirilebilir.

Zeka Nedir?

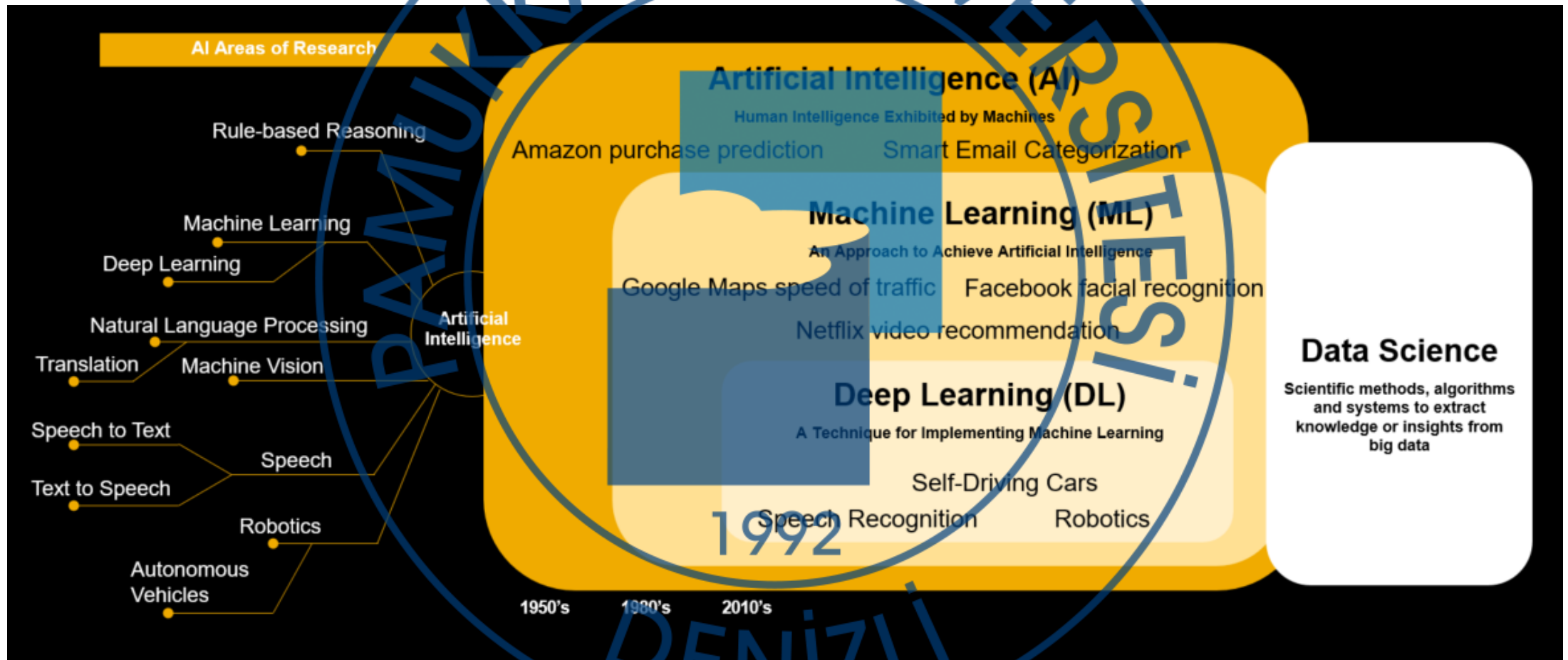
Yapay Zeka Nedir?

Yapay zekanın iki temel fikri yapıyla ilgili olduğu söylenebilir:

- Zekanın ne olduğunun anlaşılabilmesi için insan düşünce sürecinin araştırılması,
- Bu sürecin bilgisayarlar, robotlar vb. aracılığıyla gösterilmesi, somutlaştırılmasıdır.



Artificial Intelligence



Açıklanabilirlik / Güvenilirlik / Etik



ETİK: AI'NIN ADİL, AYRIMCILIK YAPMAYAN VE ETİK KURALLARA UYGUN ŞEKİLDE TASARLANMASI VE KULLANILMASI

GÜVENİLİRLİK: AI SİSTEMLERİNİN TUTARLI, DOĞRU VE GÜVENİLİR SONUÇLAR ÜRETMESİ

AÇIKLANABİLİRLİK: AI KARAR SÜREÇLERİNİN İNSANLAR TARAFINDAN ANLAŞILABİLİR VE AÇIKLANABİLİR OLMASI

Ölçeklenebilirlik

- Kaynak Yönetimi ve Optimizasyonu
- Sistem ve Uygulama Mimarisinin Esnekliği
- Performans ve Verimlilik
- Maliyet Etkinliği



Problem

Traditional Medical Image Reading

Shortage

Up to **97%** of the medical imaging departments **can't meet the reading demand**

Delays

Patients can **wait up to 12 hours** for initial scan results in ED

Error-Prone

40 Million Reported Diagnostic Errors Annually

Solution

Deep Learning-Enhanced Medical Image Reading

Improved Capacity

Deep Learning Boosts the Capacity of Radiologists

Faster Reporting

Instant Emergency Notifications, faster reading time, reduced costs

More Accurate

Reduced errors using AI as a second readers, reduced costs

1992

hStroke

AI-Powered Triageing For
the Most Critical
Medical Emergency



hChestXR

AI-Powered Reading For
the Most Frequently
Used Diagnostic
Modality



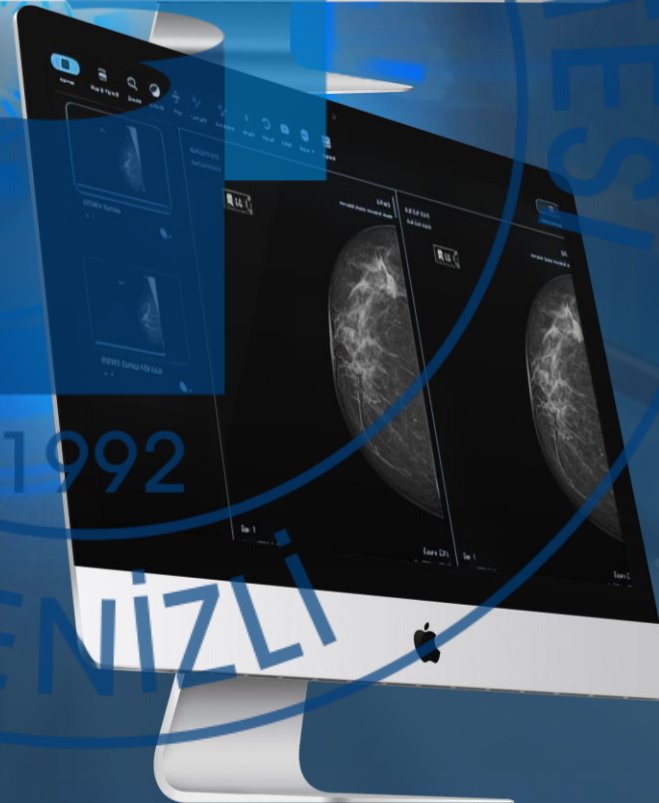
hProstate

AI-Powered
MRI Reading for the Most
Common Cancer In Men

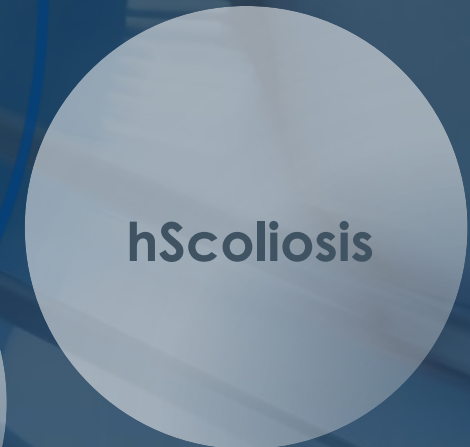


hBreastMMG

AI-Powered
Mammography Reading
for the Most Common
Cancer In Women



HEVI AI Platform: More to come.



hStroke

AI-based Smart Emergency Triage

- Employs deep learning for rapid and accurate neuroimaging diagnostics.
- Identifies brain hemorrhages, vessel occlusion, and ischemic stroke.
- Seamless PACS integration for efficient collaboration and result review.



Publications: hStroke

scientific reports

OPEN

A joint convolutional-recurrent neural network with an attention mechanism for detecting intracranial hemorrhage on noncontrast head CT

Deniz Aliş^{1,2}, Ceren Aliş^{1,2}, Mert Yergin³, Cagdas Topel⁴, Ozan Asmakutlu⁵, Omer Bagcilar¹, Yeseeren Deniz Senli⁶, Ahmet Ustundag⁶, Vefa Salt⁶, Sebahat Nacar Dogan⁷, Murat Velioglu⁸, Hakan Hatem Selcuk⁹, Batuhan Kara⁹, Caner Ozer¹⁰, Ilkay Oksuz¹⁰, Osman Kizilkilic⁶ & Ercan Karaarslan¹

To investigate the performance of a joint convolutional neural networks-recurrent neural networks (CNN-RNN) using an attention mechanism in identifying and classifying intracranial hemorrhage (ICH) on a large multi-center dataset; to test its performance in a prospective independent sample consisting of consecutive real-world patients. All consecutive patients who underwent emergency non-contrast-enhanced head CT in five different centers were retrospectively gathered. First, neuroradiologists created the ground-truth labels. The development dataset was divided into the training and validation set. After the development phase, we integrated the deep learning model into an independent center's PACS environment for over six months for assessing the performance in a real clinical setting. Three radiologists created the ground-truth labels of the testing set with a majority voting. A total of 55,179 head CT scans of 48,070 patients, 28,253 men (58.77%), with a mean age of 53.84 ± 17.64 years (range 18–89) were enrolled in the study. The validation sample comprised 5211 head CT scans with 903 being annotated as ICH positive. The model achieved a sensitivity, specificity, and precision on the validation set were 99.41%, 99.70%, and 99.91%, respectively. During the prospective implementation, the model yielded an accuracy of 99.02% on 452 head CT scans with an average prediction time of 4.5 ± 8 s. The joint CNN-RNN model with an attention mechanism yielded excellent diagnostic accuracy in assessing ICH and its subtypes on a large-scale sample. The model was seamlessly integrated into the radiologist workflow. Though slightly decreased performance, it provided decisions on the sample of consecutive real-world patients within a minute.

Intracranial hemorrhage (ICH) is a life-threatening condition with high mortality rates^{1,2}. ICH might occur spontaneously or due to head trauma, and regardless of the underlying cause, non-contrast head CT is the method of choice for the radiological diagnosis³. The rapid and accurate diagnosis is crucial as the clinical deterioration often occurs within the first few hours after ICH onset. Furthermore, there is a need for precise estimation of ICH subtypes, namely intraparenchymal hemorrhage (IPH), intra-ventricular (IVH), subarachnoid (SAH), subdural (SDH), and epidural hemorrhage (EDH), as the type of ICH closely relates with the prognosis and treatment.

≥99% Sensitivity in detecting brain bleeding on head CT

≥95% Sensitivity in detecting large vessel occlusion on brain CT angiography

scientific reports

OPEN

Automated LVO detection and collateral scoring on CTA using a 3D self-configuring object detection network: a multi-center study

Omer Bagcilar^{1,2,3}, Deniz Aliş^{4,5,6,7}, Ceren Aliş¹, Mustafa Ege Seker¹, Mert Yergin⁸, Ahmet Ustundag⁹, Emil Hikmet¹, Alperen Tezcan¹, Gokhan Polat⁷, Ahmet Tugrul Akkus⁷, Fatih Alper⁷, Murat Velioglu⁸, Omer Yildiz⁹, Hakan Hatem Selcuk⁹, Ilkay Oksuz¹⁰, Osman Kizilkilic⁶ & Ercan Karaarslan¹

The use of deep learning (DL) techniques for automated diagnosis of large vessel occlusion (LVO) and collateral scoring on computed tomography angiography (CTA) is gaining attention. In this study, a state-of-the-art self-configuring object detection network called nnDetection was used to detect LVO and assess collateralization on CTA scans using a multi-task 3D object detection approach. The model was trained on single-phase CTA scans of 2425 patients at five centers, and its performance was evaluated on an external test set of 945 patients from another center. Ground-truth labels for the presence of LVO and collateral scores were provided by three radiologists. The nnDetection model achieved a diagnostic accuracy of 98.26% (95% CI 96.25–99.36%) in identifying LVO, correctly identifying 945 out of 945 CTA scans in the external test set. The CTA-based collateral scores had a kappa of 0.80, indicating good agreement with the consensus of the radiologists. These results demonstrate that the self-configuring 3D nnDetection model can accurately detect LVO on single-phase CTA scans and provide semi-quantitative collateral scores, offering a comprehensive approach for automated stroke diagnostics in patients with LVO.

According to the World Health Organization, 15 million people suffer from a stroke attack every year, resulting in 5–6 million deaths and 5 million disabilities. Ischemic stroke with large vessel occlusion (LVO) is the most severe type of ischemic stroke, and approximately one-third of ischemic strokes are caused by LVO¹. Mechanical thrombectomy is the standard treatment for acute ischemic stroke with LVO, as several large-scale studies in 2015 demonstrated its benefits in restoring blood flow in eligible patients^{2,3}.

Early diagnosis of LVO is crucial for the success of mechanical thrombectomy, as the chances of achieving functional independence decrease with delays⁴. Computed tomography angiography (CTA) has become the standard for acute stroke imaging in assessing LVO⁵. It also provides information about collateral status, which is useful for decision-making in mechanical thrombectomy^{6,7}. The severe consequences of delayed diagnosis of LVO and the inter-observer variations among radiologists in assessing collateral status in ischemic stroke patients necessitates automated diagnosis^{8,9}.

scientific reports

OPEN

Inter-vendor performance of deep learning in segmenting acute ischemic lesions on diffusion-weighted imaging: a multicenter study

Deniz Aliş^{1,2}, Mert Yergin³, Ceren Aliş¹, Cagdas Topel⁴, Ozan Asmakutlu⁵, Omer Bagcilar¹, Yeseeren Deniz Senli⁶, Ahmet Ustundag⁶, Vefa Salt⁶, Sebahat Nacar Dogan⁷, Murat Velioglu⁸, Hakan Hatem Selcuk⁹, Batuhan Kara⁹, Ilkay Oksuz¹⁰, Osman Kizilkilic⁶ & Ercan Karaarslan¹

There is little evidence on the applicability of deep learning (DL) in the segmentation of acute ischemic lesions on diffusion-weighted imaging (DWI) between magnetic resonance imaging (MRI) scanners of different manufacturers. We retrospectively included DWI data of patients with acute ischemic lesions from six centers. Dataset A (n = 2986) and B (n = 3951) included data from Siemens and GE MRI scanners, respectively. The datasets were split into the training (80%), validation (10%), and internal test (10%) sets, and six neuroradiologists created ground-truth masks. Models A and B were the proposed neural networks trained on datasets A and B. The models subsequently fine-tuned across the datasets using their validation data. Another radiologist performed the segmentation on the test sets for comparisons. The median Dice scores of models A and B were 0.858 and 0.857 for the internal tests, which were non-inferior to the radiologist's performance, but demonstrated lower performance than the radiologist on the external tests. Fine-tuned models A and B achieved median Dice scores of 0.832 and 0.846, which were non-inferior to the radiologist's performance on the external tests. The present work shows that the inter-vendor applicability of deep learning for the segmentation of ischemic lesions on DWI might be enhanced via transfer learning; thereby, their clinical applicability and generalizability could be improved.

Ischemic stroke is a significant public health problem and one of the leading causes of mortality and disability worldwide¹. Ischemic stroke is routinely diagnosed using neuroimaging modalities, such as computed tomography (CT) and magnetic resonance imaging (MRI)². Given that CT is widely available and has a shorter acquisition time, it is now recommended to use CT over MRI due to the importance of initiating treatment early³. Nevertheless, MRI offers valuable information in challenging cases and better delineation of ischemic lesions in the early stages of the disease due to its unsurpassed contrast resolution^{4,5}. Furthermore, the volume of the ischemic core assessed using diffusion-weighted imaging (DWI) provides essential insights for decision-making. DWI is beneficial by allowing evaluation of the vascular territory of the stroke lesions, predicting whether a patient with stroke will be benefited from the treatment⁶. Also, it might serve as a potential non-invasive biomarker.

Non-inferior to radiologists in segmenting ischemic lesions on DWI

hProstate

AI-Powered Prostate MRI Reading Experience

- Advanced AI for streamlined prostate MRI interpretations.
- Automates measurements, calculations, scores, and cancer detection.
- Reduces workload and improves prostate cancer management. Deployment in late 2023.



hProstate

Ranked in Top #5

World Largest Prostate Cancer Detection Challenge

1367 Participants. HeviAI Beat Siemens, Radboudumc NL, The Netherlands Cancer Institute, and Shanghai University.

#	User (Team)	Algorithm	Created	Score
1st	joeran.bosma	DataScientX (N. Debus, A. Routier, et al.; France) algorithm trained on PI-CAI: Private and Public Training Dataset	10 June 2023	0.814
2nd	joeran.bosma	BDAV_Y (Y. Yuan, et al.; Australia) algorithm trained on PI-CAI: Private and Public Training Dataset	24 May 2023	0.800
3rd	joeran.bosma	Swangeese (H. Kan, et al.; China) algorithm trained on PI-CAI: Private and Public Training Dataset	15 May 2023	0.795
4th	joeran.bosma	PI-Med-Stanford (X. Li, S. Vesia, S. Saunders, et al.; USA) algorithm trained on PI-CAI: Private and Public Training Dataset	8 June 2023	0.779
5th	joeran.bosma	HeviAI (A. Karagoz, et al.; Turkey) algorithm trained on PI-CAI: Private and Public Training Dataset	31 March 2023	0.754



hChestXR

AI-Based Chest X-Ray Reading

- Rapid and accurate chest X-ray interpretation using AI.
- Identifies 10 most common pathologies, significantly reducing radiologists' workload.
- Seamless PACS integration ensures efficient access and updates. Set for release in Q1 2024.



hBreastMMG

AI-Based Mammography Reading

- Cutting-edge AI technology for efficient interpretations of mammography images.
- Automates measurements, calculations, density scoring, and cancer detection.
- Significantly reduces workload and enhances breast cancer management. Expected deployment in late 2024.



Sales Models



On-Premises

License

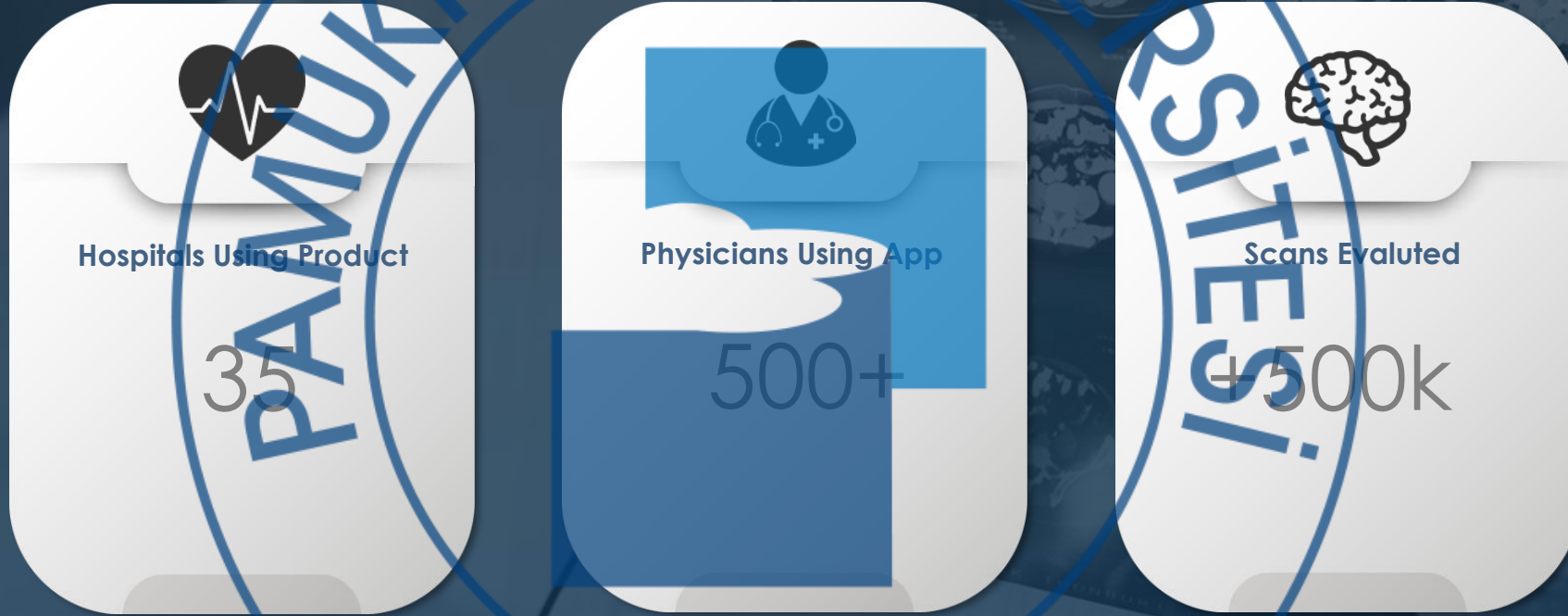


In the Cloud

License / Per-Use

Traction

We Move Forward Confidently



ACIBADEM

AMERİKAN
HASTANESİ

KOÇ ÜNİVERSİTESİ
HASTANESİ



İSTANBUL İL SAĞLIK MÜDÜRLÜĞÜ
İSTANBUL EĞİTİM ARAŞTIRMA HASTANESİ



Atatürk
University



Let me Take You Through 2023-2025

Product-Specific Expansion

- ❑ **hStroke & hChestXR:** Expansion into the European Emergency Network is in talks with Cem Calli of European Society of Emergency Radiology.
- ❑ **hStroke:** Plans to expand into the Balkans and the MENA Stroke Network. Partnership discussions are ongoing with Serdar Geyik of ICURE.
- ❑ **hBreastMMG:** Projected expansion through a partnership with GE Healthcare, targeted for Q1 2025. Point of contact is Erkin Aribal.
- ❑ **hScoliosis:** Targeting an expansion into the MENA region and Asia by Q2 2025. Discussions underway with Azmi Hamzaoglu and AeroRad
- ❑ **hProstate:** Targeting an expansion into Europe, MENA, and the United States. Plan to use Hacettepe and Baris Turkey (lead radiologist in Prostate imaging)

Supporters & Partners



TÜBİTAK



KULUÇKA

Merkezi

TÜRKİYE



BANKASI



Microsoft
for Startups

SIEMENS
Healthineers

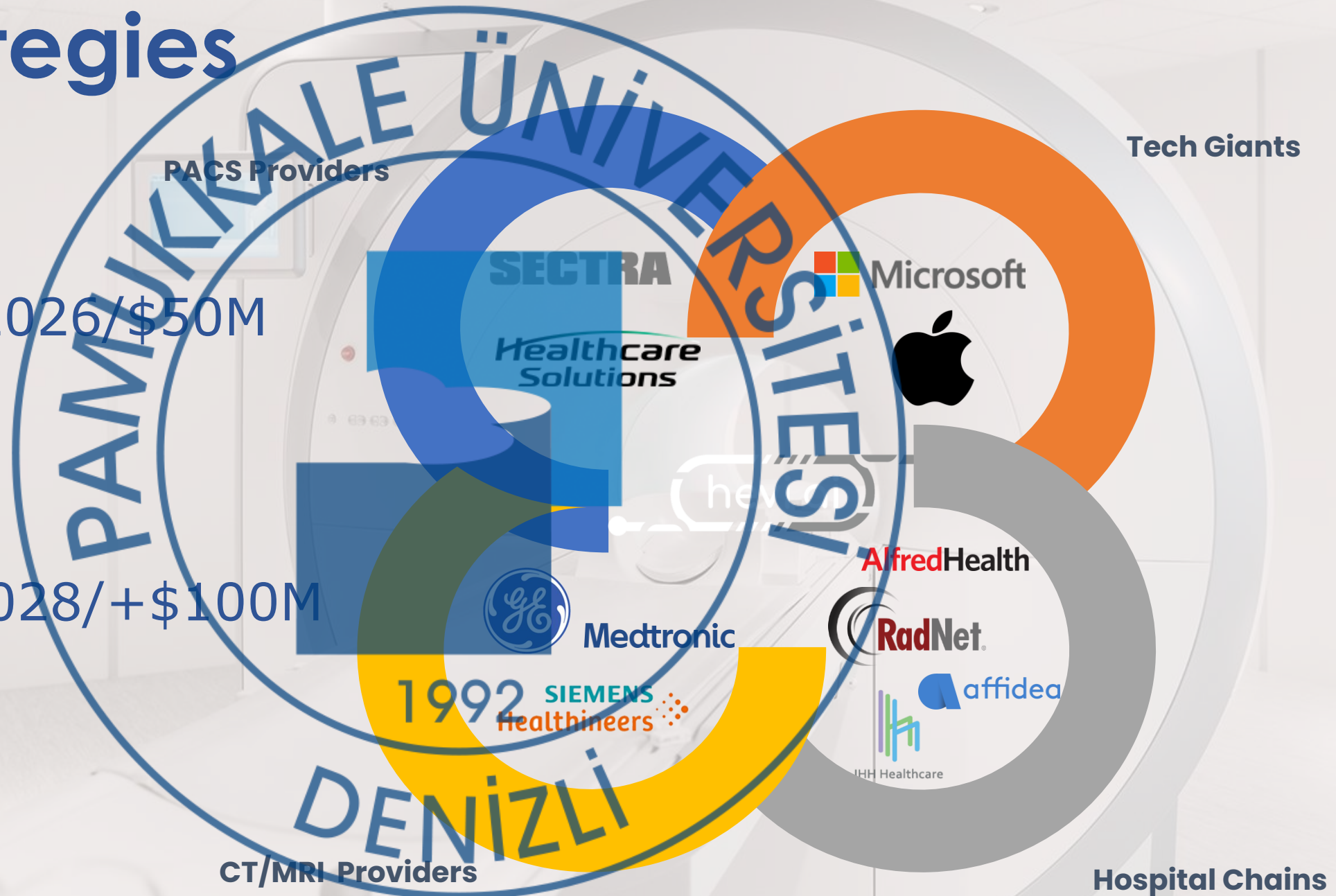


TEB



Exit Strategies

- ❑ Early Exit 2026/\$50M
- ❑ Late Exit 2028/+\$100M



The background features a large, faint blue circular logo of Pamukkale University. The logo contains the text 'PAMUKKALE ÜNİVERSİTESİ' at the top and 'DENİZLİ' at the bottom. In the center of the logo is a stylized blue figure of a person with arms raised, holding a blue rectangular sign that says 'hevi ai' in white lowercase letters. The figure has a white head with a small white dot for an eye and a white line for a mouth. The background also has a blue and orange light trail on the left side and a network of blue lines and dots on the right side.

Your Health & Our Vision!

contact

E-mail: ahmet.karagoz@hevi.ai