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Hoboken

Single Day Event

July 18th 2019
Stevens Institute of Technology, Hoboken

Artificial Intelligence and the Digital Transformation of Healthcare

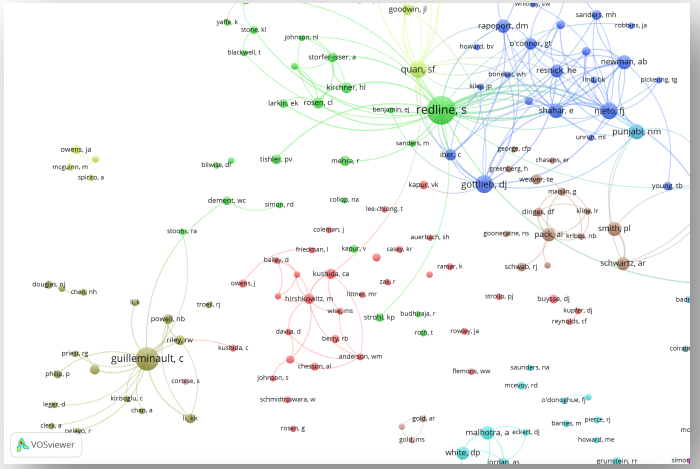
Industry – Academic Partnership

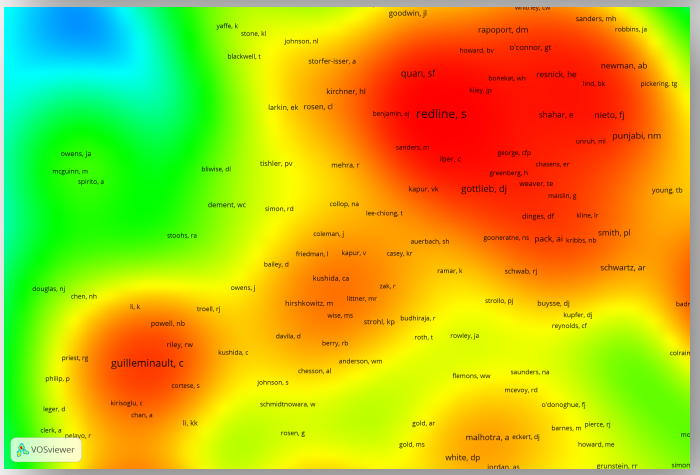
Genesis Research and Stevens School of Business

Dr. Chris Asakiewicz, Stevens School of Business

Dr. Frank Corvino, Genesis Research

DECISION ANALYTICS AND BIG DATA





Healthcare and Life Sciences

The availability of large quantities of clinical, biological, and healthcare data promises unprecedented advances for the diagnosis and treatment of disease as well as the improvement of patient health; however, the appropriate use of this data mandates changes in the traditional paradigms of data management, analysis, and interpretation.

Industry-Academic Partnership

RESEARCH AND DEVELOPMENT

How to Create Productive Partnerships With Universities

Too often, companies pursue collaboration with university researchers in an ad hoc, piecemeal manner. But by giving more thought to the relationship structure, companies can achieve better results.

BY MARKUS PERKMANN AND AMMON SALTER

THE LEADING QUESTION
How can companies work most effectively with universities?

FINDINGS
- Companies' relationships with universities are too important to be managed in an ad hoc fashion.
- When structuring a collaboration, managers should consider two key dimensions: time horizon and degree of openness.
- Each model of industry-university collaboration has benefits and draw-backs; the best format will depend on the goals and capabilities of both partners.

COMPANIES INCREASINGLY recognize that to successfully innovate they cannot exclusively rely on their internal R&D. Working with external partners allows them to access different pools of knowledge and save R&D costs.[1] Universities are among the external partners that offer high promise, since they allow access to an enormous global pool of talent and skills.

Sometimes managers think dealing with universities equals only "technology transfer." While the use of university-owned intellectual property[2] has spurred much innovation in business, it is only the tip of the iceberg. Rather than merely licensing inventions, another often-underappreciated opportunity for companies is to get help from universities during the whole life cycle of their innovation projects.[3] For example, in the United Kingdom, businesses already spend more than 20 times more on university collaboration than on licensing technology from universities.[4]

However, working with universities poses considerable challenges for managers.[5] Two fundamental issues afflict collaboration. First, the open nature of academic science is at times in conflict with companies'

The pharmaceutical companies Novartis, GlaxoSmithKline, Merck and Pfizer have invested together in open science initiatives even though they are otherwise fierce competitors.

COURTESY OF NOVARTIS

FINDINGS[1]

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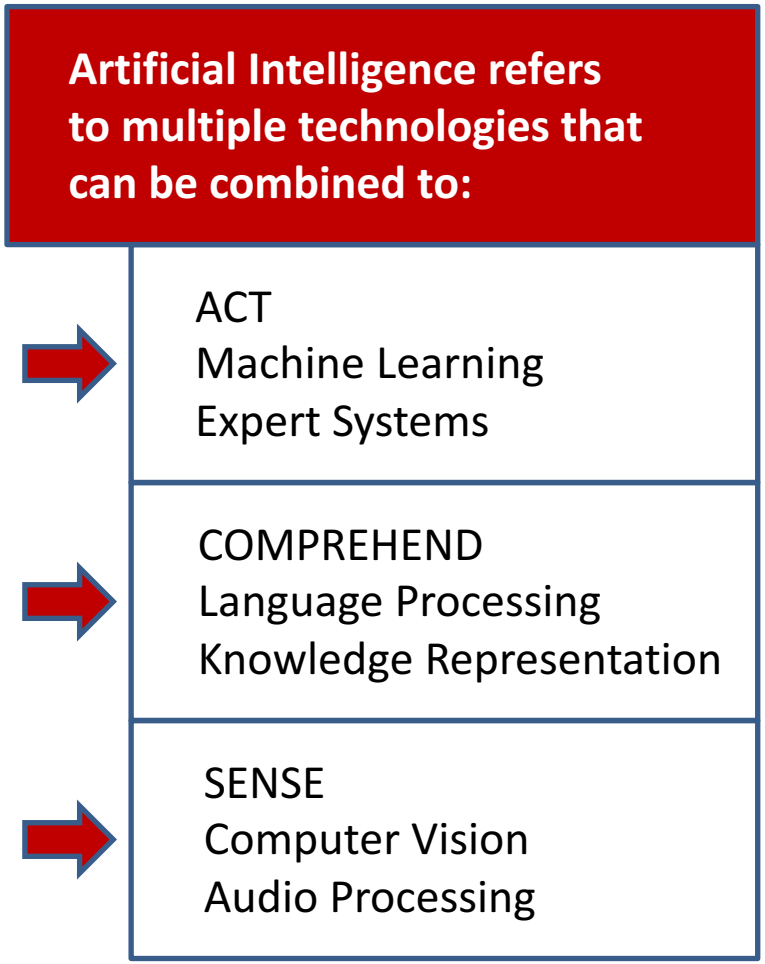
[1]Markus Perkmann and Ammon Salter, MIT Sloan Management Review, Summer 2012, Vol. 53, No.4

Industry-Academic Partnership

FOUR MODELS OF INDUSTRY-UNIVERSITY COLLABORATION

Objective	IDEA LAB	GRAND CHALLENGE	EXTENDED WORKBENCH	DEEP EXPLORATION
What do you want to achieve?	• Attract new partners • Build relationships • Generate options	• Shape innovation ecosystem • Develop research agenda • Meet societal challenges • Hire talented graduates	• Solve near-term problems • Gain advice and support	• Tackle fundamental challenges • Access new areas of expertise • Access pipeline of discoveries • Hire talented graduates
How can you structure the collaboration?	• Simple and standardized contracts • Open calls • Outline research priority areas • Internal selection	• Special purpose vehicles • High-leverage industry consortia • University endowment or centers	• Consulting agreements with individual academics • Contract research agreements with university • Student projects	• University center sponsorship • Framework agreements allocating decision rights to downstream intellectual property
Examples	• HP Labs Innovation Research Program • IBM Faculty Awards	• Structural Genomics Consortium • Shell Grand Challenge	• Nokia Applied Research Contracts	• Pfizer-Scripps Partnership • Rolls-Royce University Technology Centers

AI & Machine Learning



Source: Accenture, 2016, "Why is AI the Future of Growth"

Concepts

AI refers to multiple technologies that can be combined in different ways to sense, comprehend and act with the ability to learn from experience and adapt over time.

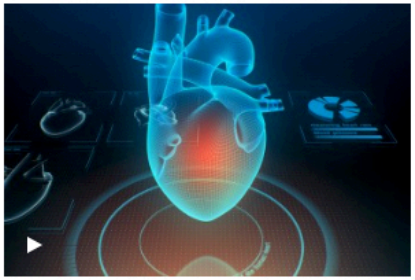
AI is a broad area of computer science that makes machines and computer programs capable of problem solving and learning, like a human brain. AI includes Natural Language Processing ("NLP") and translation, pattern recognition, visual perception and decision making.

Machine Learning ("ML"), one of the most exciting areas of AI, involves the development of computational approaches to automatically make sense of data – this technology leverages the insight that learning is a dynamic process, made possible through examples and experiences as opposed to pre-defined rules.

AI & Machine Learning

STEVENS INSTITUTE OF TECHNOLOGY

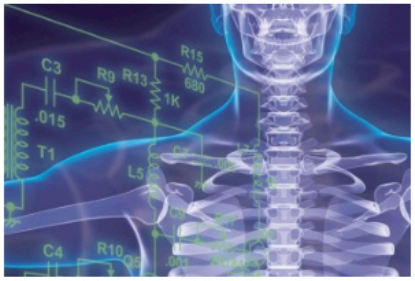
Professors K.P. Subbalakshmi and R. Chandramouli have built an AI-fueled application that has demonstrated it can detect early-warning signs of Alzheimer's disease, dementia and aphasia by analyzing text and voice based communications.



Stevens professor Negar Tavassolian develops new ways of imaging the surface of the skin and sensing our heartbeats, then processes those signals with new algorithms curated to intelligently detect skin cancer tumors and irregular heartbeats.

Dr. Giuseppe Ateniese's team has developed a powerful password cracker by using the power of GANs to learn commonly used password patterns. It's promising for its applications to law enforcement in cracking terrorist communications and other uses.

Professor German Creamer has introduced boosting as a proper method to combine and select financial indicators and generate algorithmic trading rules-including social network indicators-to forecast asset price trends.

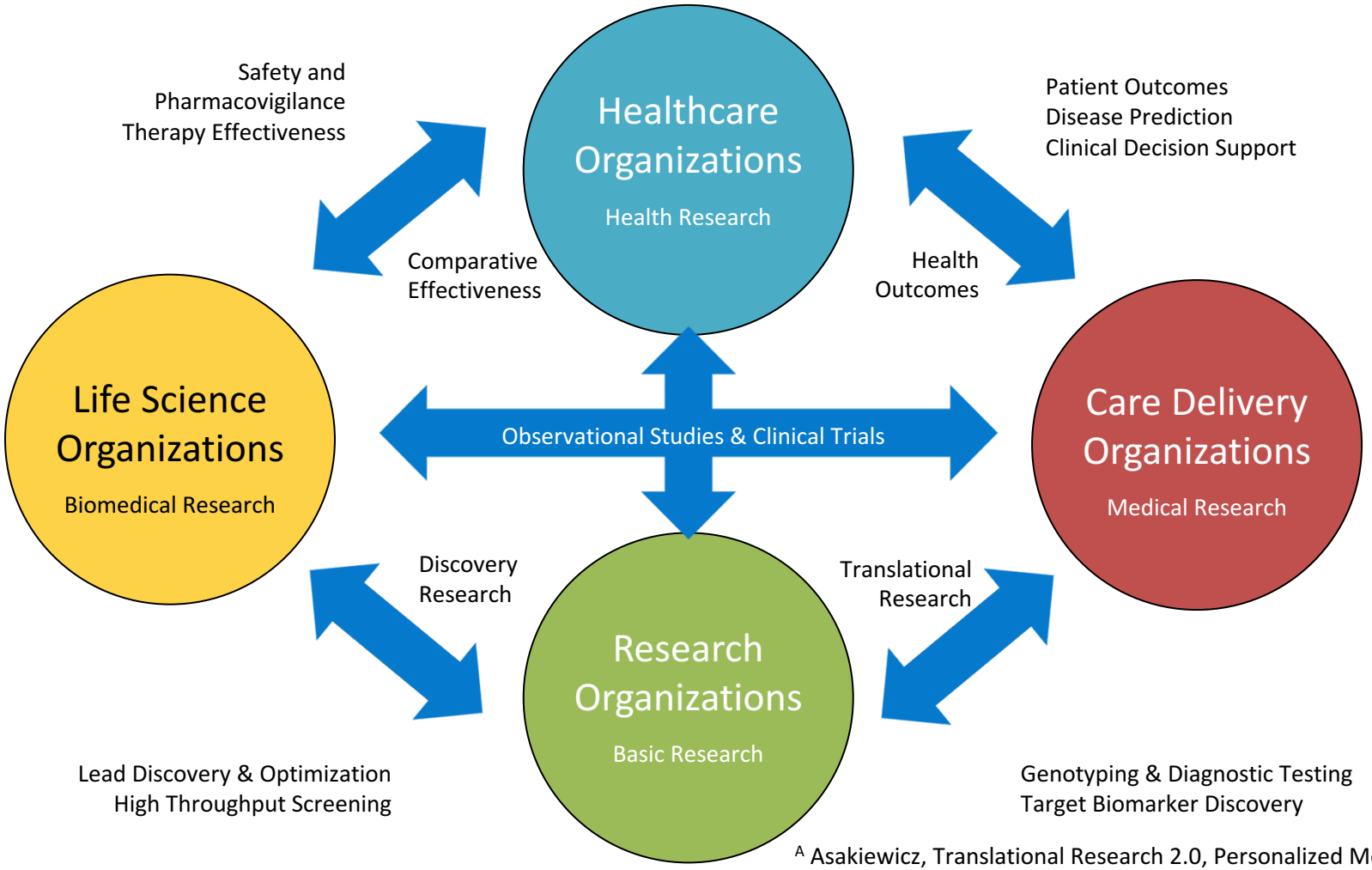


Professor Samantha Kleinberg uses machine learning to analyze sensor data from stroke patients in medical centers, research that will better inform stroke diagnosis and treatment.

Professor Brendan Englot, a robotics expert, uses machine learning to teach remotely operated underwater vehicles (ROVs) to build better maps in real time as they navigate in murky, changing conditions inspecting bridges, piers, pipes and ships.

MEDICAL AND HEALTHCARE RESEARCH

Interconnected Ecosystem [A]



[A] Asakiewicz, Translational Research 2.0, Personalized Medicine, 2014

MEDICAL AND HEALTHCARE RESEARCH
Interconnected Ecosystem

Health Care - AI is able to make sense of vast amounts of medical history and genetic data and provide insights that can be used to diagnose patients, determine the appropriate course of treatment and monitor that treatment.

Drug Development - With its ability to parse huge amounts of data and find patterns in ways that humans cannot, AI technology can be an invaluable supplement to the clinical data required to bring a drug product to market.

Digital Imaging - MRIs, cat scans, x-rays and all other diagnostic scans produce data in the form of digital images. These images can hold the key to a patient's condition and ultimate survival, but they must be expertly read and analyzed by doctors and used to create the most effective treatment plan.

Diagnosis and Treatment - Beyond simply retrofitting the AI technology that already exists, developments are also underway to fine tune it to meet niche health care demands. Deep-learning algorithms can help doctors diagnose and treat patients more accurately and effectively.

Detection and Prevention - Prevention is the best medicine and, in this vein, wearable medical devices equipped with AI to detect and predict potentially life-threatening events such as blood-glucose spikes and heart attacks are under development.

APPLIED TO THE ANALYSIS OF RWD AND RWE

Definitions of Real-World Data and Real-World Evidence (FDA Framework— Real-World Evidence Program)

Section 505F(b) of the FD&C Act defines RWE as "data regarding the usage, or the potential benefits or risks, of a drug derived from sources other than traditional clinical trials" (21 U.S.C. 355g(b)). In developing its RWE program, FDA believes it is helpful to distinguish between the sources of RWD and the evidence derived from that data. Evaluating RWE in the context of regulatory decision-making depends not only on the evaluation of the methodologies used to generate the evidence but also on the reliability and relevance of the underlying RWD; these constructs may raise different types of considerations. FDA defines RWD and RWE as follows:

- **Real-World Data (RWD) are data relating to patient health status and/or the delivery of health care routinely collected from a variety of sources.**
- **Real-World Evidence (RWE) is the clinical evidence about the usage and potential benefits or risks of a medical product derived from analysis of RWD.**

APPLIED TO THE ANALYSIS OF RWD AND RWE

RWD and RWE include:

- Insurance claims and billing activities
- Pharmacy and specialty pharmacy dispensing data
- Electronic health records (EHR) data
- Aggregated clinical lab-testing data
- Genomic data Patient registries related to specific diseases and products
- Patient-generated data (for instance, from in-home, mobile and wearable devices and sensors)
- Patient-reported outcomes data
- Behavioral data and insights collected from social media
- Purpose-built databases

APPLIED TO THE ANALYSIS OF RWD AND RWE

RWD and RWE-informed efforts include:

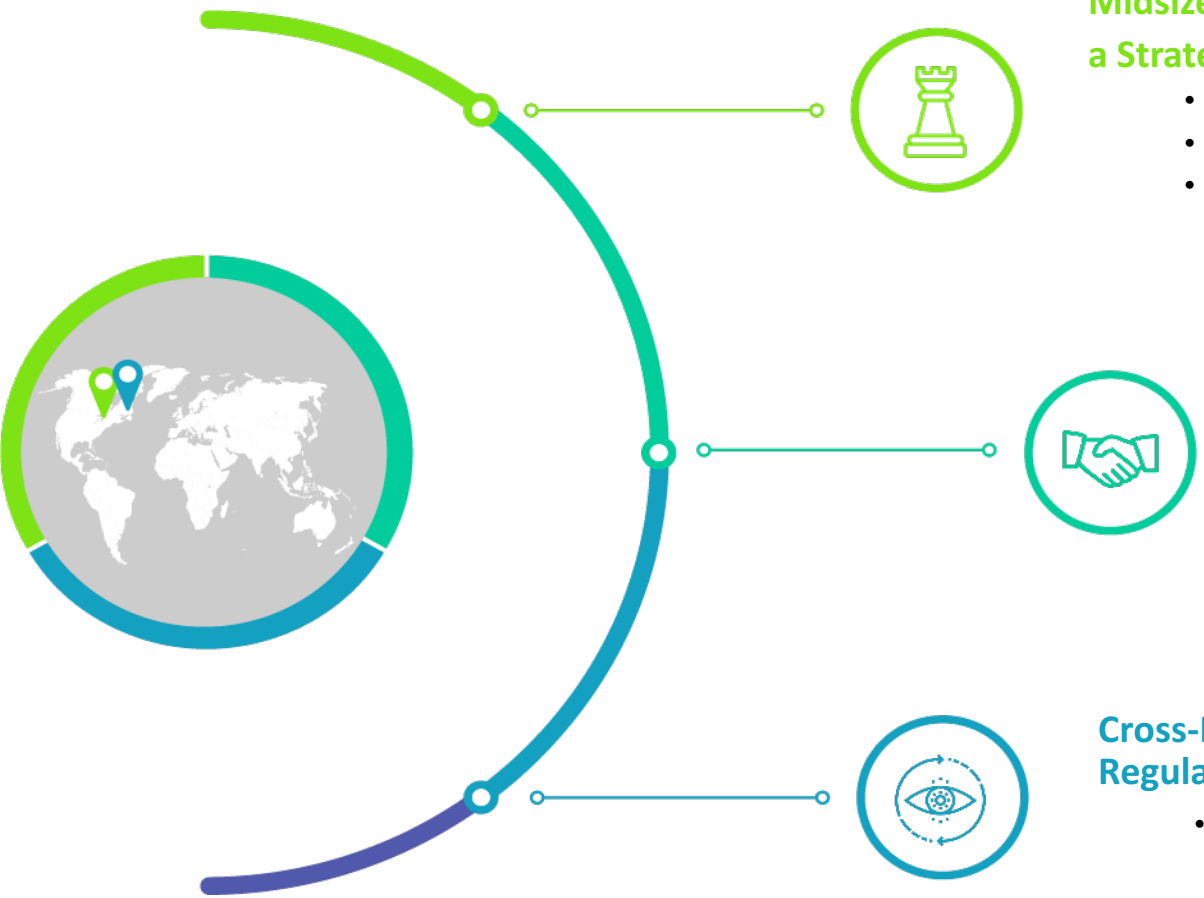
- Identifying new drug targets and better biomarkers
- Finding new uses for existing and late-stage products
- Identifying undiagnosed, under-diagnosed and misdiagnosed illness
- Identifying sites with higher enrollment probability and capability to aid
- clinical trial recruitment
- Predicting patients who have higher risk for adverse events
- Predicting medication compliance (or lack thereof) in defined patient cohorts (which can inform mitigation efforts)
- Using AI and machine-learning techniques to recognize trends and patterns
- in social media and healthcare sensor data (to inform clinical study development and define study objectives, patient-relevant endpoints and study procedures)

APPLIED TO THE ANALYSIS OF RWD AND RWE

RWD and RWE Issues include:

- Heterogeneous data and lack of interoperability
- Data incompleteness, inconsistency and inaccuracy
- Data ownership and data-use agreement status
- Data privacy regulation / patient-level authorization / ongoing patient consent management for RWD usage
- Lack of data standards
- Lack of standard unique patient identifiers to enable linking across data sources
- Multiple data sources and the need for data aggregation
- Shortage of biomedical and informatics expertise to successfully leverage modeling, simulation and AI and machine learning opportunities

Genesis Research – Who We Are



Midsize consultancy established in 2009 with a Strategic Vision and Tactical Expertise

- Clients always work with Genesis' **senior staff**
- Provide **holistic support** from strategy to tactics
- Lean, flexible and nimble approach to client engagement

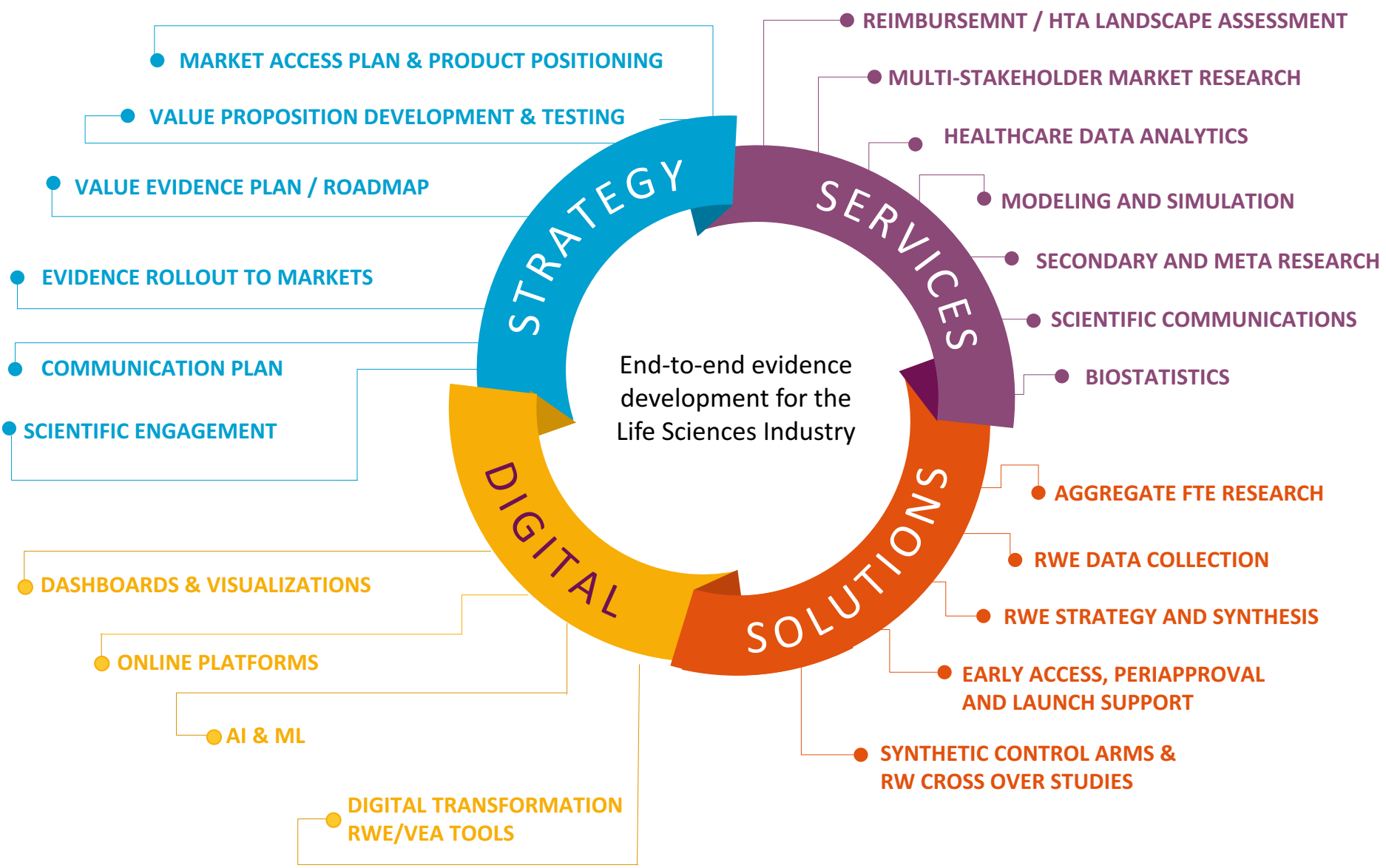
Novel Client Engagement Process

- Less of a service provider, more of a **partner**
- Works in both Ad-hoc and **Extended Back-Office (EBO)** engagements with various departments

Cross-Functional Offerings to Support Regulatory, HEOR and Market Access

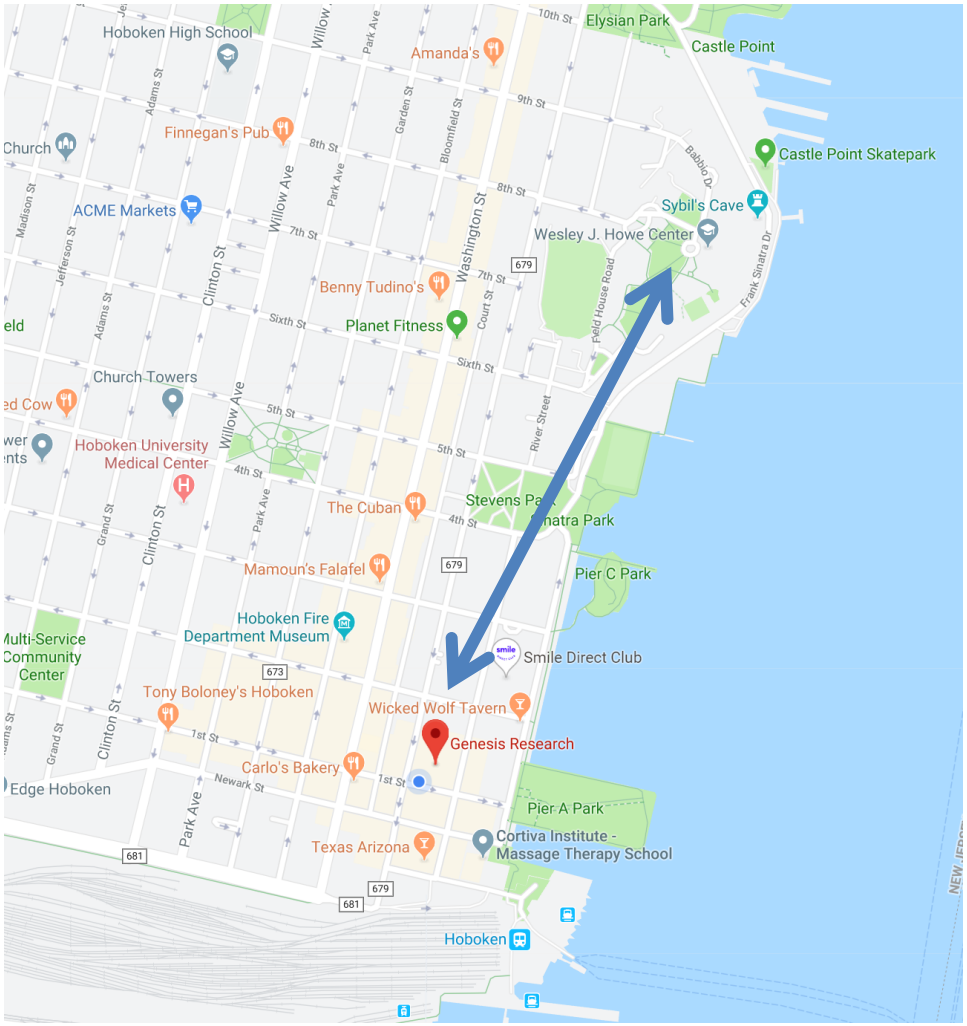
- **Understanding of Market Access Context** to drive Strategy and Tactics
- **Tactical evidence generation** across HEOR and RWE (claims, EMR, chart review)
- Significant experience and **expertise across Therapeutic Areas and Products**

Genesis Research – What We Do



Genesis Research – Who Do We Support

Why Work with Stevens – School of Business



We are very close!

Why Work with Stevens – School of Business

Some of the reasons why we chose Stevens as an academic partner:

- Genesis leadership is comprised of Stevens alumni who are very familiar with rigor of scientific approach, business-oriented focus, and innovative sprit honed at Stevens
- **Experts:** Collaborative, applied research teams complementary to Genesis skills and proficiencies allowing for flexible and scalable approach to complex problems
- **Students:** Ability to engage enthusiastic, professional, and talented students and interns who easily embrace Genesis working atmosphere
- **Knowledge:** Exposure to the latest knowledge, insights and best practices on current and emerging trends in the areas of Big Data Analytics, AI and Machine Learning, Cybersecurity, Leadership and Innovation.
- Conferences!!!

Current Phase of Engagement with Stevens

AI AND ML APPLIED TO THE ANALYSIS OF RWD AND RWE

PILOT: AI/ML applications for automation of qualitative research – using NLP techniques for data identification and extraction from pooled research resources

RWE-based diagnostic applications – predicting undiagnosed, or at-risk patients

AI/ML for RWD management – performing fit-for-purpose multiple imputation of data with variable data sparsity in different data sources

AI/ML applications for automation of quantitative retrospective research – using NLP and recommender systems to automate replication of study criteria in analyses of large databases to validate or replicate past research

Looking forward to long and successful collaboration

THANK YOU

GENESIS RESEARCH

PROMISED | DELIVERED

STEVENS INSTITUTE of TECHNOLOGY

School of Business