

RHEST FRAMEWORK

Rural Health: Evaluation and Selection of Technology



University of Minnesota

CLINICAL AND TRANSLATIONAL
SCIENCE INSTITUTE

UNIVERSITY OF MINNESOTA
Driven to DiscoverSM

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OFFICE OF ACADEMIC
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OVERVIEW

Recent advances in technology are generating new research efforts to improve the collective understanding of health outcomes in rural populations. There are multiple frameworks, methods, and guides for implementing health-related technology; however, there are few resources to guide researchers earlier in the process. The following framework will provide researchers a set of tools and resources to guide technology analysis and selection for rural health research. As the availability of health-related technology increases, a systematic approach toward an informed selection process will optimize research opportunities. The RHEST Framework includes information provided by researchers and service providers on rural health challenges, trends, and emerging technologies. Best-practice tools and methods from science and technology leaders have been adapted and included in the following process.



Figure 1: High-level depiction of the RHEST Framework.

Drivers

Minnesota has 30-40% of its population living in rural areas, depending on how rural is defined. The difficulties in improving rural health are significant. In many situations, such as stroke care, health outcomes are worse in rural than in urban areas, primarily due to reduced access to quality care. The awareness in the disparities in rural areas is becoming a focus for many organizations. In October 2019, Drs. Bruce Blazar, Director of the University of Minnesota Clinical and Translational Science Institute (CTSI), and Jakub Tolar, VP for Clinical Affairs, sent out a broad call-to-action:

“It is unconscionable that someone’s access to healthcare depends on their ZIP code. Yet, for many Minnesotans, that is a fact of life. They don’t receive the benefits of living near a large medical center with specialists and researchers who offer state-of-the-art therapies or clinical trials.”

In 2005, the National Institutes of Health took a giant step toward equalizing this disparity with the Clinical and Translational Science Awards. The program emphasizes smoothing the path of research from bench to bedside, by connecting research efforts, sharing best practices and solutions, and ‘engaging patients and communities in every phase of the translational process.’ This ties closely to our land-grant mission of improving the health of Minnesotans as we work to eliminate disparities caused by geography, economic status, and other factors.

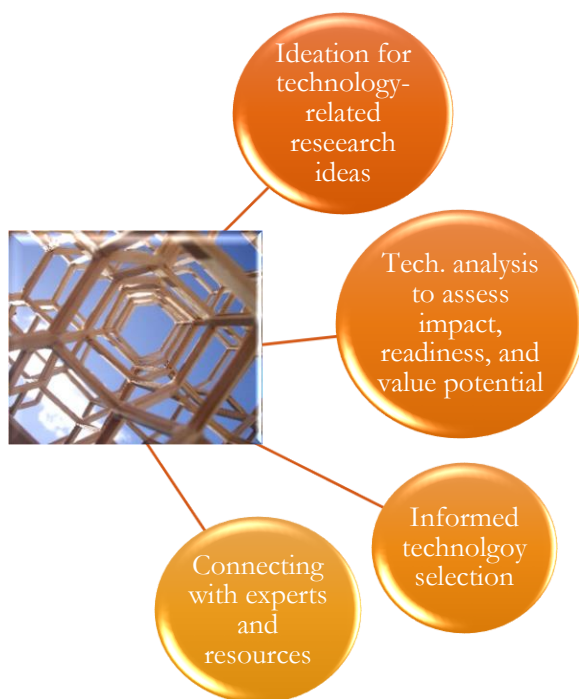
Our own Clinical and Translational Science Institute (CTSI), in the second year of its current five-year award, brings tremendous advantages for researchers and trialists. It can help us learn and better understand what our communities want, need, and find missing in their current medical care. It offers resources available to help investigators at every level of experience.”

Intended Audience

Version 1.x of the guide is intended for any researcher considering the use of emerging or existing technologies in their rural health research. The current focus is UMN-centric and is also broadly applicable for a Minnesota audience. Future versions will expand past the “research” focus and beyond Minnesota.

Framework Purpose

The guide will aide rural health researchers in:



Value

This document is intended to provide a framework for researchers to follow when selecting appropriate technologies and connecting to available experts in support of their research in the rural health space. The guide can help generate new ideas, enable informed technology selection, strengthen the decision process, and allow connections with existing resources. Finally, the use of the tools will help prepare the foundation for a robust research proposal.

How to Use This Guide

The methods and information in this document can be used as a stepwise approach for those early in the process. Researchers who have begun taking steps to implement technologies in rural health research can still use sections and tools of this guide for further support. The guide contains four parts:

1. **IDEATION:** Get started by exploring some resources early and identify potential research ideas using the “Ten Types of Innovation.” Generate a technology or research idea list. Even if you already have a specific technology selected, this section can expand your options in various categories.
2. **ANALYSIS:** Pare down the technology list. Select from various technology tools to guide evaluation and selection. Consider the research team's capability, trends in technology and rural health, policy, and cost. Connect with various experts and available rural health resources for help.
3. **DECISION:** Make the final selection and use a systematic process to lay the foundation needed for advancing the research project through the next steps.
4. **RESOURCES:** The resource catalog is the simplest to access at any time, for any purpose. Use the list to rapidly connect to available experts, data sources, and services.

I. IDEATION

A CLEAR PLACE TO BEGIN

Begin your journey by visiting and contacting the **Rural Health Information Hub**, or RHIhub, located at www.ruralhealthinfo.org.

The staff at the Center for Rural Health at the University of North Dakota maintain RHIhub with the latest information on rural health issues, funding opportunities, state and federal **data sources**, case studies, news articles, and **expert contact** information.

For a primer on **health information technology (HIT)** in rural healthcare, be sure to visit RHIhub's HIT site at <https://www.ruralhealthinfo.org/topics/health-information-technology>. It is suggested to call or email for help finding information on available resources and referrals.

1-800-270-1898. info@ruralhealthinfo.org

RURAL HEALTH CHALLENGES

Be sure to explore and understand what the challenges are for achieving **high-quality care** in rural areas. Below are some examples:

- Access to quality care
- Low revenues leading to hospital and clinic closures
- Income disparities
- Medical history data sharing
- Lack of nurses in Minnesota schools
- Aging population
- Infrastructure for clinical trials
- Availability of medical specialists
- Discrete mental health care

RURAL AND URBAN DIVIDE IN MINNESOTA

It is necessary to understand the social divide between rural and urban communities. The RHIhub lists several social determinants of health for rural Minnesota¹, including:

Factor	Rural MN	Urban MN or MN-Wide
2017 avg. per capita income	\$44,350	\$54,359 (MN-wide)
2017 Poverty rate	11.5%	8.9% (urban)
2013-2017 No high school diploma	9.0%	6.7% (urban)
2018 Unemployment	3.6%	2.7% (urban)

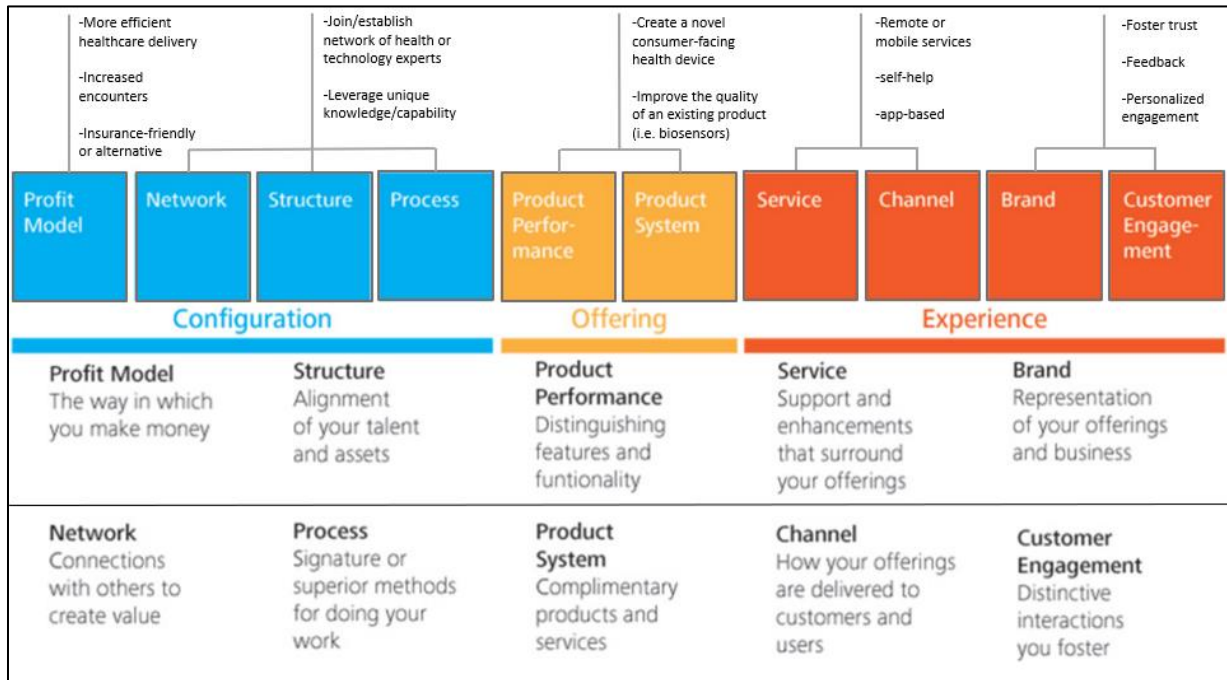
EMERGING TECH

Nearly every facet of daily life is impacted by technology. Rural health is no exception. One example is **telehealth, which is now available in over 1,800 public schools** with the reach of over 1 million students, primarily in rural areas.² Here are some examples of broad technology areas that are impacting rural health today:

- Telehealth
- Advanced imaging
- Digital health
- Artificial intelligence
- Data analytics
- Mobile phone applications
- Remote monitoring
- Robotics

TEN TYPES OF INNOVATION

Determine your rural research focus area based on your expertise and interest areas. It is common to consider a specific challenge or need related to **healthcare access, condition, population, technology product, or service**. Review the “Ten Types of Innovation” diagram below and consider how each innovation type may apply to a potential research area for rural health. For more information on this tool, see: <https://doblin.com/ten-types>.



Adapted from: Larry Keeley, Ryan Pikkell, Brian Quinn, and Helen Walters, *Ten Types of Innovation: The Discipline of Building Breakthroughs* (Hoboken, New Jersey: John Wiley & Sons, 2013).

TRENDS MATRIX

Looking at various trends can help to narrow down a focus area early in the process. Specifically consider **rural health challenges**, or other noteworthy trends, and various **emerging technologies**. Use the matrix below to gauge how these trends influence the advancement of the technologies. For more information on this tool, visit:

<https://www.boardofinnovation.com/tools/tech-trends-matrix/>.

		Emerging Technology						Strength	Net	Tension
Score ++ + + or 0 - --		1 Tech.	2 Tech.	3 Tech.	4 Tech.	5 Tech.	6 Tech.			
Rural Health (RH) Challenges (or other RH Trends)	1 RH challenge / trend	+	-	++	0	++	-	7	3	4
	2 RH challenge / trend	--	+	+	+	0	0	5	1	4
	3 RH challenge / trend	++	+	+	0	-	-	6	2	4
	4 RH challenge / trend	+	-	+	+	+	+	7	3	4
	5 RH challenge / trend	0	0	+	-	++	0	4	2	2
	6 RH challenge / trend	+	+	+	--	-	0	6	0	6
Strength (sum abs. values)		6	6	7	5	7	3			
Net (algebraic sum)		3	0	7	-1	3	-1			
Tension (Strength minus Net)		3	6	0	6	4	4			

CHECK EXTERNAL RESOURCES

Explore various experts and data sources, as noted in Section 4 of this guide (pg. 12). **Write down your list of ideas or technologies** to use for rural health research. If you have a list of about ten or so, proceed to the next section to try some analysis tools to pare down the list.

2. ANALYSIS

Take your list of technologies from section 1 and apply them to any of the tools below. Refine the options and strengthen the justification for your research path.

STRENGTH VS. VALUE

Use this simple tool to compare each idea's potential value to rural health and your capability to study or develop the plan further. **Tip:** For additional refinement of ideas, adjust the y-axis to a different measure, such as cost or technology proliferation.

Capability to Study/Develop	LEADING	Tech. #10	Tech. #7	Tech. #3
	STRONG	Tech. #2	Tech. #6 Tech. #1	Tech. #8 Tech. #4
	CAPABLE	Tech. #5		Tech. #9
		Low	Medium	High
		Value to Rural Health		

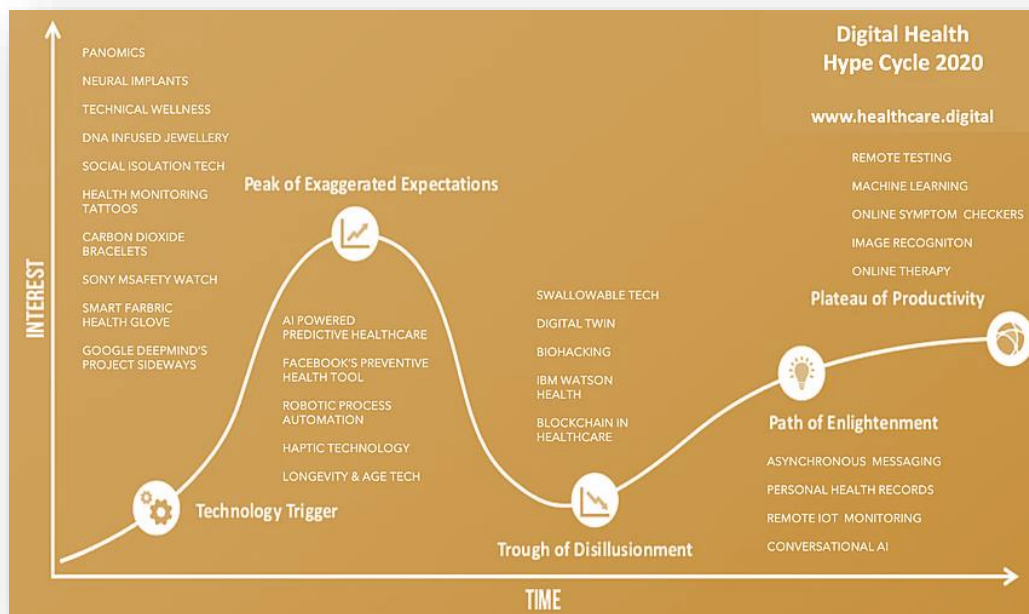
HYPE CYCLE

Expert analysts often plot various technologies against a hype curve, based on the [Gartner Hype Cycle](#). Gartner discovered that technologies typically follow a **predictable pattern** of early **exaggerated interest** before the noise dies down, and the technology eventually **becomes reliable**. One example is the 2020 digital health hype cycle below.

Search for existing hype cycles that list the technologies in which you are interested. If you cannot find a specific technology, carefully review existing literature to get a sense of the level of **investment occurring in the technology, patents, and existing applications**.

Appropriately match your research idea with the state of the technology. For example, if you are developing some novel use of a new technology that will require several years of research and business partnerships, then it may be acceptable for the technology to appear earlier on the curve.

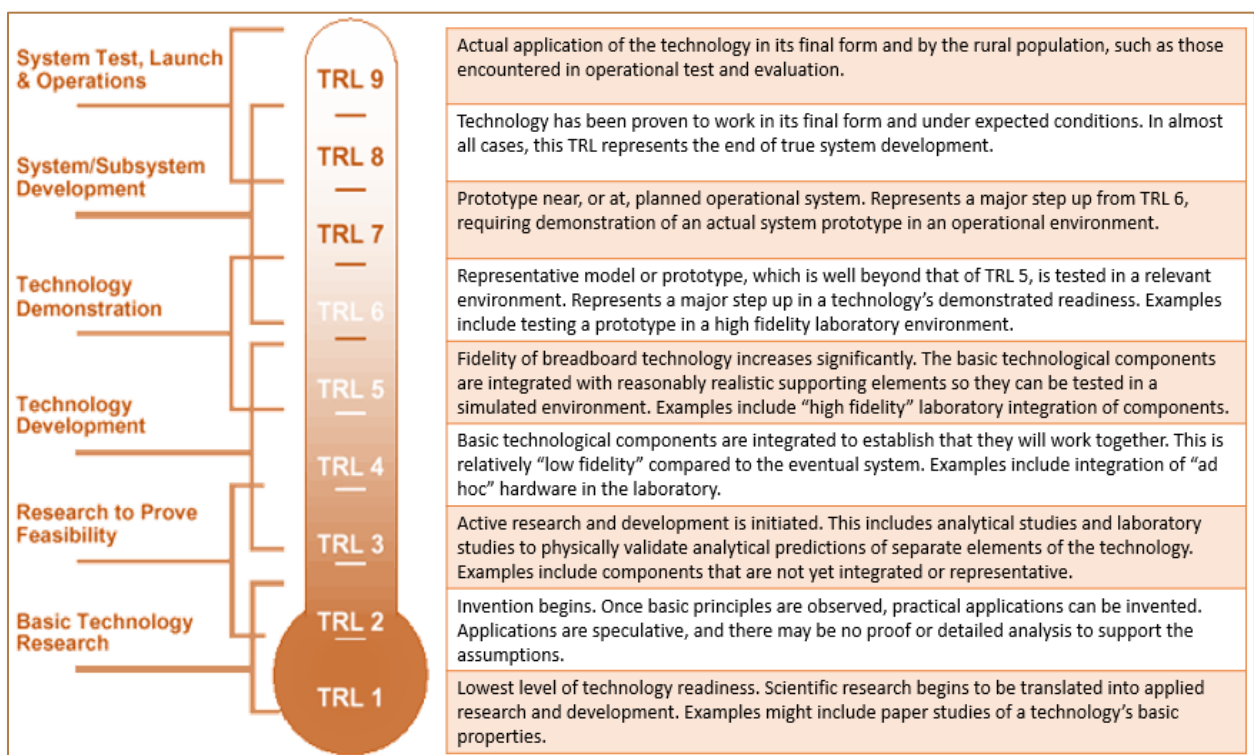
Tip: If you are expecting your research to have an immediate broad impact, you may want to focus on the items listed along the Path of Enlightenment or Plateau of Productivity, below. For additional information on this tool, see: <https://www.cleverism.com/everything-need-know-gartner-hype-cycle/> and <https://www.youtube.com/watch?v=2e416wjdKaY>.



Source: Lloyd Price, *Digital Health Hype Cycle 2020*, <https://www.healthcare.digital/single-post/2020/01/29/Digital-Health-Hype-Cycle-2020>, January 29, 2020.

TECHNOLOGY READINESS LEVELS

Technology Readiness Levels (TRLs) provide a consistent way to **determine the maturity status** of technology products. NASA initially developed TRLs and they have also been used by the **National Institutes of Health (NIH)**. The TRL scale operates from 1 to 9, where 1 is the least mature and 9 is fully in-use. The tool can also be useful in identifying appropriate technology funding for technologies ready to advance. Tier Seven provides a dynamic **online biomedical TRL** with examples of research activity for each level and specific TRL biomedical topic areas such as clinical interventions and medical informatics. Access the Tier Seven site here: <https://tier7.us/trls/biomedical-trls/>. See here for more information: <https://www.youtube.com/watch?v=in4TnQZGYj4>.



Sources: Thermometer Image from NASA TRLs, table adapted from the Department of Defense's Technology Readiness Assessment (TRA) Deskbook: <https://apps.dtic.mil/docs/citations/ADA524200>

POWER ASSET-TECHNOLOGY OPPORTUNITY MATRIX

When starting a research project, it helps to **leverage the assets available** to your organization. Modify the list of research and technology power assets to those that may impact your technology opportunities. Are you already well-positioned to advance your preferred technology opportunity, or is more work needed? **Tip:** In some cases, **exploring additional partnerships or seeking outside expertise** will be required.

Item	Assets	Technology Opportunities					
		Tech. Opportunity #1	Tech. Opportunity #2	Tech. Opportunity #3	Tech. Opportunity #4	Tech. Opportunity #5	Tech. Opportunity #6
	Research & Technology Power Asset (Examples)						
1	Faculty / Researchers	+	+	+	+	+	
2	Research partnerships	+	+			+	
3	Corporate partnerships		+	+		+	
4	Clinical partnerships	+	+	+	+		
5	Data sources	+		+	+		+
6	Robotics expertise	+	+		+		+
7	Predictive analytics expertise	+	+		+	+	
8	Telehealth Research Center / gpTrac	+	+	+			
9	Rural Health Research Center				+	+	
10	Upper Midwest Agricultural Safety and Health Center (UMASH)		+			+	
	Other Power Assets (Examples)						
1	Technology: internal and external-accessible	+	+	+	+	+	+
2	Relationships with technology resources		+	+		+	+
3	Intellectual property: patents, trade secrets, skills	+	+	+	+	+	
4	Manufacturing infrastructure and processes						
5	Cash, other financial assets; resources for commercialization			+			+
6	Brand		+	+			+
7	Relationships with rural communities	+	+	+			+
8	Business processes	+	+	+	+		
9	Sales and distribution channels			+			
	Subtotal, Research & Technology Power Assets	7	8	5	6	6	2
	Subtotal, Other Power Assets	4	6	8	3	3	5
	Total	11	14	13	9	9	7

OTHER CONSIDERATIONS

Is your research idea going to help **advance a Minnesota policy issue?** Could current policy realities diminish the value of your research? Policy issues of interest in Minnesota include state **Medicaid expansion, rising healthcare costs, health information availability, data privacy, insurance accessibility,**

primary care physician shortage, and mental healthcare access. If needed, check the Resources section for information on policy experts.

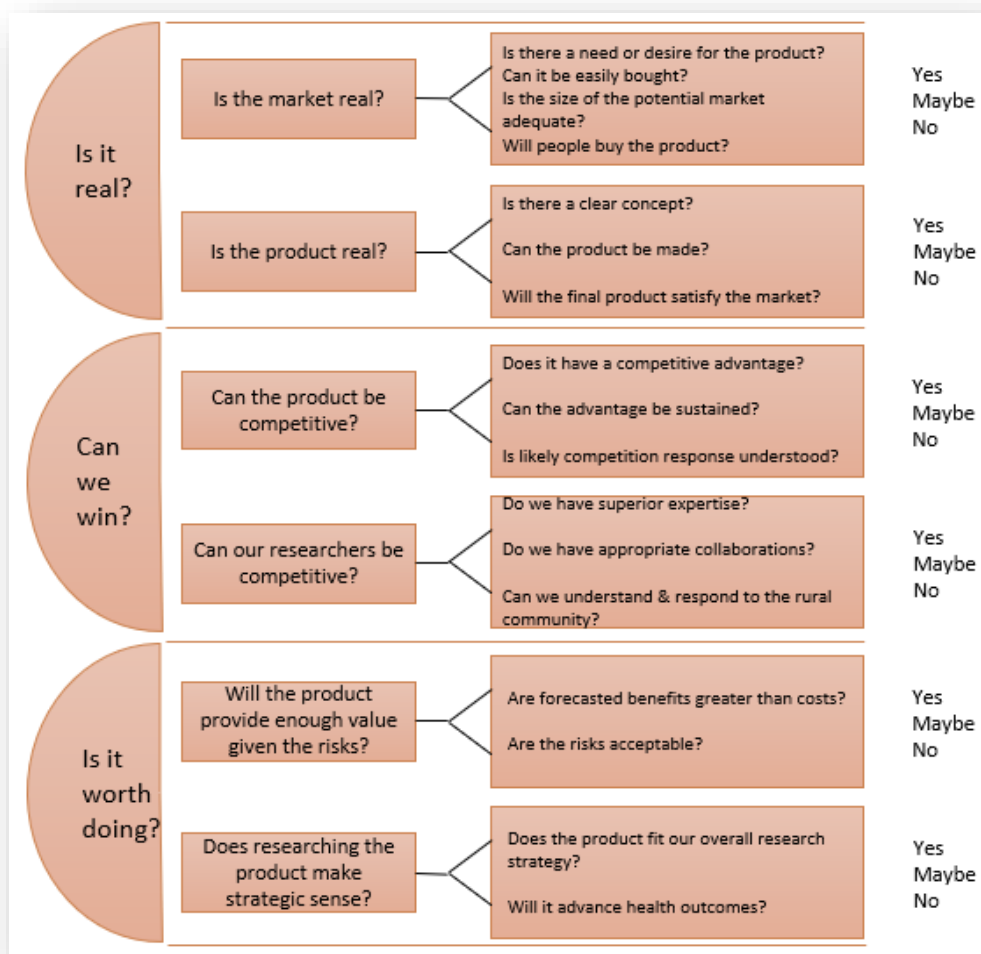
It is also essential to understand **what cost factors are of importance** to your research. Will insurance providers cover the technologies you are going to research? What about Medicaid and Medicare?

3. DECISION

Use the modified “Real-Win-Worth It (R-W-W),” and “probability of failure” tools to make a final decision on which technology opportunity to select for your rural health research. George S. Day describes both tools in detail in Harvard Business Review³. If you have already decided upon a technology, jump to the research model canvas to strengthen your proposal for further vetting or funding opportunities.

MODIFIED “REAL-WIN-WORTH IT (R-W-W)”

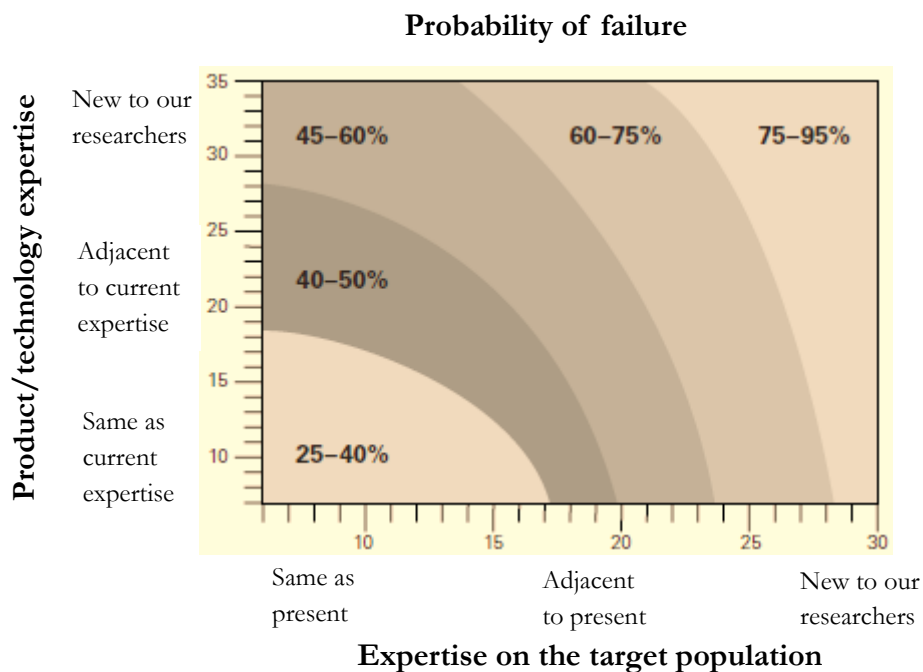
If you have a new technology product to consider including in your research, try this modified tool based on George S. Day’s R-W-W. It is **especially useful if you plan to commercialize a new product**. Day’s tool has been used by well-known companies, such as 3M, to select and launch new products or new product lines³. **Too many “maybe” or “no” responses suggest more work is needed.** For more information on this tool, visit: <https://hbr.org/2007/12/is-it-real-can-we-win-is-it-worth-doing-managing-risk-and-reward-in-an-innovation-portfolio>.



MODIFIED RISK MATRIX

Use the risk matrix to gauge the likelihood of failure for each of your technology product ideas. Note that the probability of failure goes up when the intended population and proposed technology are newer to the researcher. The matrix below was modified from George S. Day's risk matrix³, for which he defines "failure" as missing the objectives used to justify the investment in a new product as a growth initiative for a company. In a research setting, it does not mean the research itself will fail, but rather that **there may be challenges for rapid technology proliferation**. The purpose of including the modified risk matrix as a tool here is to illustrate the importance of **collaboration between experts of relevant technology and research areas**. The risk matrix shows the probability of failure is lower when the right expertise is available. If additional knowledge is needed on a specific population, consider utilizing the University of Minnesota's (UMN's) Population Center for more data and the UMN Clinical and Translational Science Institute's (CTSI's) [Community Engagement Studio](#) to directly engage a community for feedback before launching your research study. For more information on this tool, visit:

https://www.aimcal.org/uploads/4/6/6/9/46695933/mcclure_tuesday_pres.pdf.



RESEARCH START-UP CANVAS

If you have used multiple tools within the framework, you should have plenty of information to make a final decision on a technology to advance research for rural health. To **strengthen your proposal**, consider the questions in the research start-up canvas, which is a modified concept from the Business Model Canvas designed by Alexander Osterwalder and Yves Pigneur⁴. For more information on the Business Model Canvas, visit: <https://www.businessmodelsinc.com/about-bmi/tools/business-model-canvas/>

<p>Key Collaborators</p> <p>Who should we need to collaborate with?</p> <p>What additional expertise is needed?</p> <p>Who will we obtain technology products or expertise from?</p> <p>What key activities will our collaborators perform?</p>	<p>Key Activities</p> <p>What key activities do our value propositions require?</p> <p>Funding?</p> <p>Relationships?</p> <p>Acquire expertise?</p> <p>Key Resources</p> <p>What key resources do our value propositions require?</p> <p>Research relationships?</p> <p>Target population / community relationships?</p>	<p>Research Value Propositions</p> <p>What value will be delivered to science?</p> <p>Value to the target population?</p> <p>What target population needs are of focus?</p> <p>What health need will be researched?</p> <p>What health outcomes may be impacted?</p>	<p>Population Relationships</p> <p>How will we get, keep, and grow community involvement?</p> <p>What relationships are established already?</p> <p>How valuable and costly are relationships?</p> <p>Channels</p> <p>Through which channels do our target population want to be reached?</p> <p>How are they reached today?</p> <p>Which methods work best?</p> <p>What is most cost-efficient?</p>	<p>Target Population Segments</p> <p>What population segment(s) may receive value? How big are they?</p> <p>Who are the most important to involve?</p> <p>What are the archetypes represented within these segments?</p> <p>Can and will the target population be able to obtain any new technology required?</p>
<p>Cost Structure</p> <p>What are the most important costs inherent to the research plan?</p> <p>Which necessary resources are most expensive?</p> <p>Which activities are most expensive?</p> <p>Who will pay for new technology for the research? Who will pay for it if the research shows there is valuable impact to health outcomes?</p>		<p>Funding</p> <p>Grants?</p> <p>Sponsored research?</p> <p>Philanthropy?</p> <p>Seed funding?</p> <p>Technology commercialization?</p>	<p>Analysis</p> <p>What method(s) will be used?</p> <p>How will you measure the impact?</p>	

4. RESOURCES

Part of the framework includes connecting with other researchers and experts. The following rural health resources are organized by category: Minnesota, national resources, and technology expertise. Note that while some contacts may overlap categories, each resource will only be listed one time. The list is not comprehensive.

MINNESOTA RESOURCES

Clinical and Translational Science Institute (CTSI)

Support for biomedical informatics, biostatistics, biospecimens, community

engagement, multi-site studies, recruitment, and regulatory.

<https://www.ctsi.umn.edu/>
ctsi@umn.edu | 612-625-CTSI (2874)

Experts@Minnesota

Search for a UMN expert based on research output, grants, and other criteria
<https://experts.umn.edu/>

MN Community Measurement

Health care cost and quality data
<https://mncm.org/>
info@mncm.org | 612-455-2911

MN Department of Health Data, Statistics, and Legislation

Health diseases & conditions, environmental health, health care cost & quality, etc.

<https://www.health.state.mn.us/data/>
651-201-5000

MN Design Center

Consulting using human-centered design, physical & service designs, public health service delivery design

<https://designcenter.design.umn.edu/>
mdc@umn.edu

MN Population Center (MPC)

UMN-wide interdisciplinary cooperative for demographic research. Health, well-being, economic & demographic behavior, & human-environment interactions

<https://www.pop.umn.edu/>
mpc@umn.edu | 612-626-8375

MN Public Health Data Access Portal

Data on environmental issues, trends, geographic patterns and disparities.

<https://data.web.health.state.mn.us/>

MN Rural Health Association (MRHA)

Policy advocacy, engagement, education & collaboration

<https://mrha.memberclicks.net/>
218-201-0098

Office of Rural Health & Primary Care (ORHPC)

Promotes access to quality health care, funding, publications, workforce data

<https://www.health.state.mn.us/facilities/ruralhealth/>
health.orhpc@state.mn.us | 651-201-3838

Upper Midwest Agricultural Safety and Health Center (UMASH)

Collaboration for research, education, & community engagement

<http://umsh.umn.edu/>
umash@umn.edu | 612-625-8836

NATIONAL RESOURCES

Agency for Healthcare Research and Quality (AHRQ)

Healthcare system safety and quality data, research funding

<https://www.ahrq.gov/>
301-427-1104

CDC National Environmental Public Health Tracking Network

Data on environmental issues, trends, geographic patterns and disparities.

<https://ephtracking.cdc.gov/>

General Social Survey Data Explorer

Societal change data since 1972

<https://gssdataexplorer.norc.org/>
GSSHelp@norc.org

Health Resources & Services

Administration (HRSA) Federal Office of Rural Health Policy

Rural health policy, funding, hospital & community programs, & telehealth programs.

<https://www.hrsa.gov/rural-health/>
877-464-472

Health Resources & Services

Administration (HRSA) Data Explorer

Supports access to health care in rural areas, training of health professionals, funding, etc.

<https://data.hrsa.gov/tools/data-explorer>
877-464-4772

National Bureau of Economic Research (NBER)

Conduct and share economic research

<https://www.nber.org/>
info@nber.org / 617-868-3900

National Organization of State Offices of Rural health (NOSORH)

Leadership development, advocacy, education, & partnership at national & state levels

<https://nosorh.org/>
<https://www.powerofrural.org/>
888-391-7258

RHIHub

News, research, data, phone help
<https://www.ruralhealthinfo.org/>
info@ruralhealthinfo.org | 1-800-270-1898

State Health Access Data Assistance Center (SHADAC)

Data related to state and federal health policy, compare state data. Health coverage, affordability, and access data.
<https://shadac.org/>
<http://statehealthcompare.shadac.org/shadac@umn.edu> | 612-624-4802

UMN Extension

Connections with greater Minnesota to advance scientific discoveries and education. Local and tribal relationships.
<https://extension.umn.edu/>
<https://local.extension.umn.edu/local/mnext@umn.edu> | 612-624-1222

UMN Rural Health Research Center

Conducts policy-related research
<https://rhrc.umn.edu/>
rhrc@umn.edu | 612-626-8401

US Department of Agriculture (USDA) National Institute of Food & Agriculture

Human health focus on nutrition, obesity, wellness, food science, and education. Data and funding.
<https://nifa.usda.gov/>
<https://nifa.usda.gov/page/search-grant>

TECHNOLOGY EXPERTISE

American Medical Informatics Association (AMIA)

Informatics healthcare community
<https://www.amia.org/>
301-657-1291

Great Plains Telehealth Resource & Assistance Center (gpTRAC)

Telehealth education and consultation
<https://gptrac.org/>
888-239-7092

Healthcare Information and Management Systems Society, Inc. (HIMSS)

Community of sharing and learning with searchable resources and events
<https://www.himss.org/>
312-664-4467

UMN Health Sciences Technology Development and Integrations

Develop web and mobile applications
<https://it.umn.edu/service-details/health-sciences-development-integrations>
bjs@umn.edu

UMN Health Informatics Services and Consulting

Data science, biomedical AI, machine learning, predictive modeling, secondary use of EHR data, clinical trials management, natural language processing, bioinformatics, & genomics
<https://healthinformatics.umn.edu/bmhi@umn.edu> | 612-626-3348

UMN Computer Science & Engineering

Research areas in bioinformatics, robotics & AI, human computer interaction, data mining, databases, GIS, etc.
https://www.cs.umn.edu/research/research_areas
csdesk@umn.edu | 612-625-4002

UMN Technology Commercialization

Patents, licensing, start-up, IP management
<https://research.umn.edu/units/techcomm>
umotc@umn.edu | 612-624-0550

National Telehealth Technology Assessment Resource Center (TTAC)

Technology innovations, evaluation toolkits, events, and implementation technical assistance.
<http://telehealthtechnology.org>

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3. Day GS. Is it real? Can we win? Is it worth doing? Managing risk and reward in an innovation portfolio. *Harv Bus Rev*. 2007;85(12).
4. Osterwalder P& al. Business Model Canvas: nine business model building blocks. *Strategizer*. 2010.

FEEDBACK

Help improve the RHEST Framework!

Feedback is encouraged via:

<https://z.umn.edu/RHEST-feedback>

Feel free to contact the author:

Joshua A. Fehrmann
JAF@UMN.EDU
Clinical and Translational Science Institute
Office of Academic Clinical Affairs
University of Minnesota

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<https://tli.umn.edu/>

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