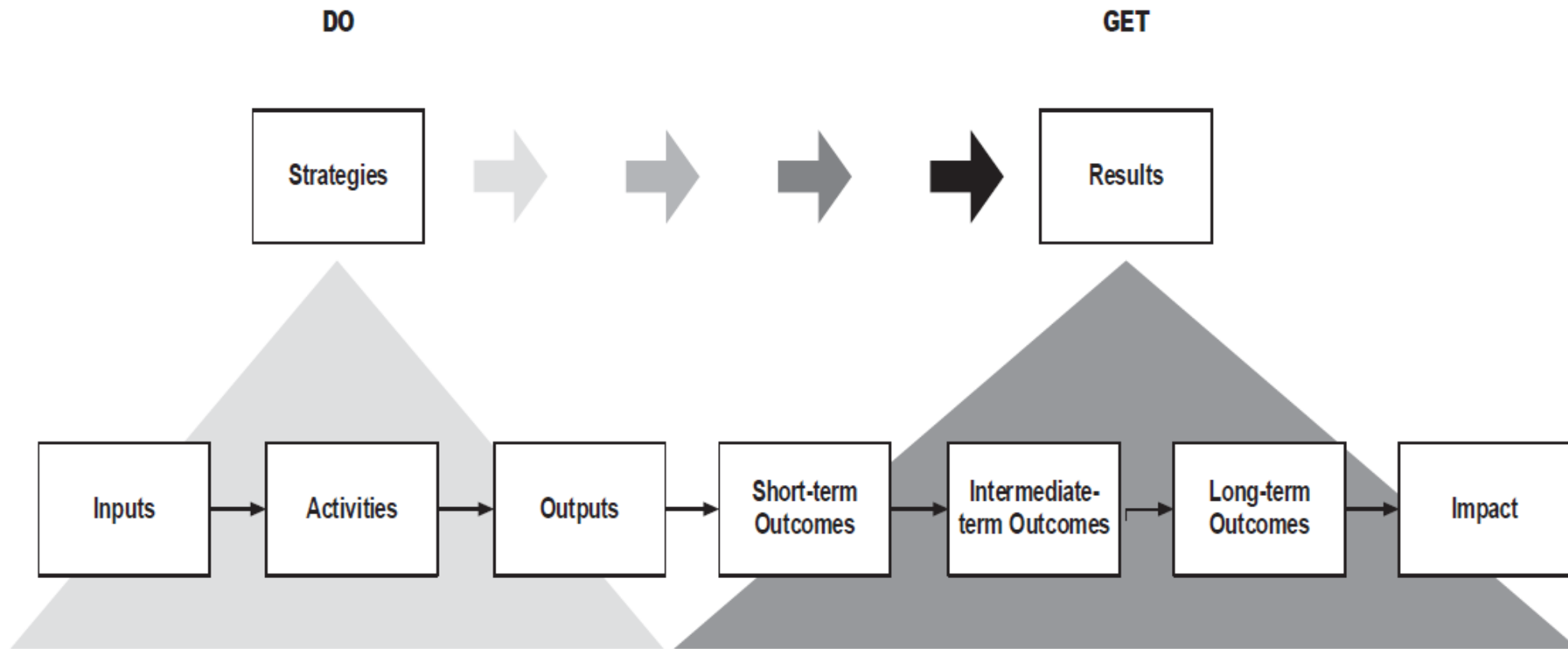


Simple Logic Model





Outputs vs. Outcomes and Impact



Program Goal(s):							
Inputs	Outputs		Expected Outcomes			Long-term Impact	Measurement Indicators
Resources	Activities	Participation	Short Term <i>By End of Year 1</i>	Intermediate <i>By End of Year 5</i>	Long Term <i>By End of Year 10</i>		

CMaT Logic Model – Center Level

RESOURCES/INPUTS

- NSF funding and ERC program resources
- NCMC Roadmap: 4 years of input from industry and clinical practitioners; current state of technology
- Talented faculty, trainees, & dedicated staff
- Excellent research and training facilities, infrastructure, GMP/GLP
- Existing and new relationships with K-12, technical colleges, & URM outreach programs
- Existing and new industry and clinical partnerships
- High-quality undergraduate and graduate programs
- Dedicated experts and researchers synergistically leading all key programs
- Biomanufacturing resources from Marcus Center and Waisman Center
- Existing and new programs for diversity and inclusion, industry ecosystem, & entrepreneurship training
- Advisory boards, NIST, FDA, SCB, patient groups, reimbursement experts
- Feedback from and engagement with regulatory and standards agencies
- Integrated and continuous evaluation

ACTIVITIES

- Comprehensive cell and process characterization, big data analytics, & predictive computational modeling for all Test-Beds
- New technology development for monitoring and assessing CQA, CPP, potency, and safety during manufacturing in all Test-Beds
- Systems optimization and process improvement; scalability; new models and theory for supply chain and logistics for all Test-Beds
- Integrate real-time monitoring of CQAs and CPPs into scalable, quality-controlled manufacturing processes for each Test-Bed
- Provide center-wide implicit bias and cultural competency training
- Share best practices across institutions and beyond
- Recruit, retain, & mentor trainees and faculty from underrepresented groups
- Provide continuous and broad professional development opportunities for faculty & trainees at all levels
- Bio-manufacturing curriculum development and dissemination – for pre-college, technical college, university, professional education
- Certificate and degree programs at technical colleges & universities
- International training program
- Continuous engagement of industry practitioners in research, innovation, inclusivity, & workforce development
- Develop and nurture a culture of translation, entrepreneurship, and commercialization

OUTPUTS

- Novel biological insights resulting in robust analytical, computational, and workflow tools for identifying CQAs & CPPs; Identified CQAs & CPPs for specific Test-Beds
- New theories, models, and technologies for rapid, high-throughput, or real-time measurement of cell quality, CQAs, and CPPs across Test-Beds
- New theories, models, & technologies for scalable Test-Bed production and distribution
- Center-wide vision of cross-cutting engineered system of closed-loop manufacturing with real-time analytics, potency measurements, and feedback process control for Test-Beds
- Center-wide, embedded culture of inclusion
- Best practices in diversity and inclusion implemented across CMaT partners and disseminated internationally
- Increased number of faculty and students from underrepresented groups active in the broader CMaT ecosystem
- Increased number of CMaT faculty and students trained in broad professional skills
- Inclusive pre-college & technical college programs, entrepreneurship enrichment modules, & teacher experience programs developed in cell manufacturing
- Inclusive, industry-driven technical college and university certificate programs developed for cell manufacturing
- Strong international program focused on training a globally engaged workforce
- Diverse portfolio of highly engaged member companies across value chain
- Best practices leading to increased technology licensing, startups, & innovation

OUTCOMES

	SHORT (1-3 YEARS)	MID (4-7 YEARS)	LONG (8-10 YEARS AND BEYOND)
Research	CMaT ecosystem advances knowledge and enables innovations that result in publications, filed patents, & new industry collaborations New research talent from associated fields begin working on areas supported by CMaT Diverse perspectives, multi-disciplinary expertise, and input from industry and clinicians synergizes to enhance R&D activities and training in CMaT	Industry & clinical input results in shorter technology/process development cycle and new research directions and projects CMaT researchers leverage CMaT projects and other infrastructure to receive additional funding from federal, state, philanthropic, or industry sources CMaT's international program results in more globally engaged, holistic researchers and increases new research collaborations CMaT trainees begin impacting industry ecosystem through diversity and inclusion, cross-disciplinary expertise, policy and regulatory awareness, and diversity	CQA/PPP driven Engineered system with rapid, real-time analytics to enable large-scale, reproducible manufacturing of high-quality cells disseminated to clinicians and industry in the U.S. and internationally CMaT faculty & trainees spin-off new U.S. companies or license technologies to other companies Faculty and trainees from traditionally underrepresented groups populate and remain in career fields supported by CMaT Industry-relevant bio-manufacturing training becomes part of engineering curricula nationwide
Engineering Workforce Development	A sustainable ecosystem links industry, global institutions, K-12 schools, technical colleges, & universities to address the current and future needs of the cell manufacturing workforce Traditionally underrepresented groups make distinct scientific contributions and interface with clinicians and industry New courses, modules, and outreach across all levels raise awareness and enthusiasm for cell and biomanufacturing careers	CMaT trainees begin impacting industry ecosystem through diversity and inclusion, cross-disciplinary expertise, policy and regulatory awareness, and diversity Training based on industry need and emphasizing global perspectives becomes an embedded part of CMaT's culture CMaT impacts establishment of best practices and standards internationally	CMaT's best practices for workforce training, innovation ecosystem, and culture of inclusion become exemplars for other programs at partner institutions and nationally CMaT's sustainability post-NSF funding
Diversity and Inclusion	Increased number of faculty and students from underrepresented groups active in the broader CMaT ecosystem Increased number of CMaT faculty and students trained in broad professional skills Inclusive, industry-driven technical college and university certificate programs developed for cell manufacturing Strong international program focused on training a globally engaged workforce	CMaT impacts regional economic development and industrial competitiveness CMaT impacts establishment of best practices and standards internationally CMaT impacts regional economic development and industrial competitiveness	CMaT's sustainability post-NSF funding CMaT's sustainability post-NSF funding
Innovation Ecosystem	Traditionally underrepresented groups make distinct scientific contributions and interface with clinicians and industry New courses, modules, and outreach across all levels raise awareness and enthusiasm for cell and biomanufacturing careers CMaT is recognized as a global leader in cell manufacturing technology development and training Faculty and trainees engage in more industry-relevant research	CMaT impacts regional economic development and industrial competitiveness CMaT impacts establishment of best practices and standards internationally CMaT impacts regional economic development and industrial competitiveness Increased quantity, quality, and filing-speed of invention disclosures	Accelerated innovation and increased commercialization

SOCIETAL IMPACTS

- Improved availability and access to reliable, high-quality, cell-based therapies
- Reduced cost of cell therapy products
- Change in clinical practice — cell therapies become more routine for clinical care
- A robust, sustainable cell manufacturing industry with well-trained, diverse, and global workforce
- Better health outcomes regardless of socio-economic status

Logic Model – Engineering Workforce Development

RESOURCES/ INPUTS

NSF funding and ERC program resources

NCMC Roadmap with 4 years of input from industry and clinical practitioners

Excellent research and training facilities and world-class infrastructure, Marcus and Waisman center ecosystem

Dedicated GMP/GLP facility for training

Talented faculty, trainees, and dedicated staff

Industry-driven research strategies and results

High-quality undergraduate and graduate programs

Engaged industry, and clinical partners, regulatory and standards experts, & CMAAT Advisory boards

Existing and new relationships with K-12, technical colleges, and URM outreach programs

ACTIVITIES

High school research internships, RET, and flipped RET programs, supported by mentoring programs

Technical college course modules, mentoring partnerships

Undergraduate course modules, REU programs, MSI partnerships

Inter-institutional graduate courses; new credentials if desirable

Partnerships to develop professional education course modules for retraining current workforce

CMAAT virtual symposium, annual retreat, SLC, inter-institutional courses, research exchanges, mentoring network

International exchange and training program

Internships and entrepreneurship training opportunities

OUTPUTS

Pre-college implementation of CMAAT-related curricula and enrichment experiences, pre-college student participation

CMAAT content integrated into technical college coursework; technical college student and instructor participation

CMAAT content integrated into undergraduate and graduate programs; diverse group of trainees

Student understanding of industry and clinical challenges and regulatory, standards, ethical, legal, economic, & policy issues

CMAAT course modules and training content from all levels and best practices disseminated internationally

Inclusive inter-institutional research collaborations, co-presentations, co-publications, co-mentoring

Increased number of faculty and students from underrepresented groups active in the broader CMAAT ecosystem

Students trained in global industry and research culture, regulatory and standards issues, and global entrepreneurship

Positive student and mentor satisfaction ratings and clear goals for internship and entrepreneurship experiences

SHORT (1-3 YEARS)

New programs attract student interest in engineering and biomanufacturing at the pre-college, technical college, and college levels, especially among underrepresented groups in engineering

Industry-relevant curricula, pedagogical approaches, technical and professional skills, and strategies for broadening participation are developed at all levels

Increased number of underrepresented students at preparatory colleges enter programs for careers in biomanufacturing

Increased numbers of diverse undergraduate and graduate engineers begin receiving key technical and professional skills necessary to transform the nascent cell manufacturing industry

An ecosystem of sustainable partnerships begins to link industry, global research partners, K-12 schools, technical colleges, and universities to address current and future workforce needs

Precollege, technical college, & college instructors' initial engagement with CMAAT builds enthusiasm for initial infusion of cell manufacturing concepts into engineering education at all levels

OUTCOMES

MID (4-7 YEARS)

Mature programs increase student commitment to engineering and biomanufacturing at the pre-college, technical college, and college levels, especially among underrepresented groups in engineering

Industry-relevant curricula, pedagogy, technical & professional skills, and broadening participation strategies are enacted and revised at all levels at partner sites and by technical colleges and K-12 schools

Increased number of underrepresented students entering and graduating from preparatory colleges prepared for careers in biomanufacturing

Increased numbers of diverse undergraduate and graduate engineers graduating with key technical and professional skills necessary to transform the cell manufacturing industry

An ecosystem of sustainable partnerships strengthens and expands links among all stakeholders to address current and future needs of the global cell manufacturing workforce

Instructors' ongoing engagement with CMAAT furthers continued infusion of cell manufacturing concepts into engineering education at all levels

LONG (8-10 YEARS ... AND BEYOND)

Sustainable programs across CMAAT drive increased student commitment to biomanufacturing at all levels, especially among underrepresented groups in engineering; CMAAT training used as an exemplar nationwide

Industry-relevant curricula, pedagogy, technical & professional skills, and strategies for broadening participation are adopted as exemplars at institutions beyond CMAAT

Steady flow of underrepresented students entering and graduating from preparatory colleges prepared for evolving careers in biomanufacturing

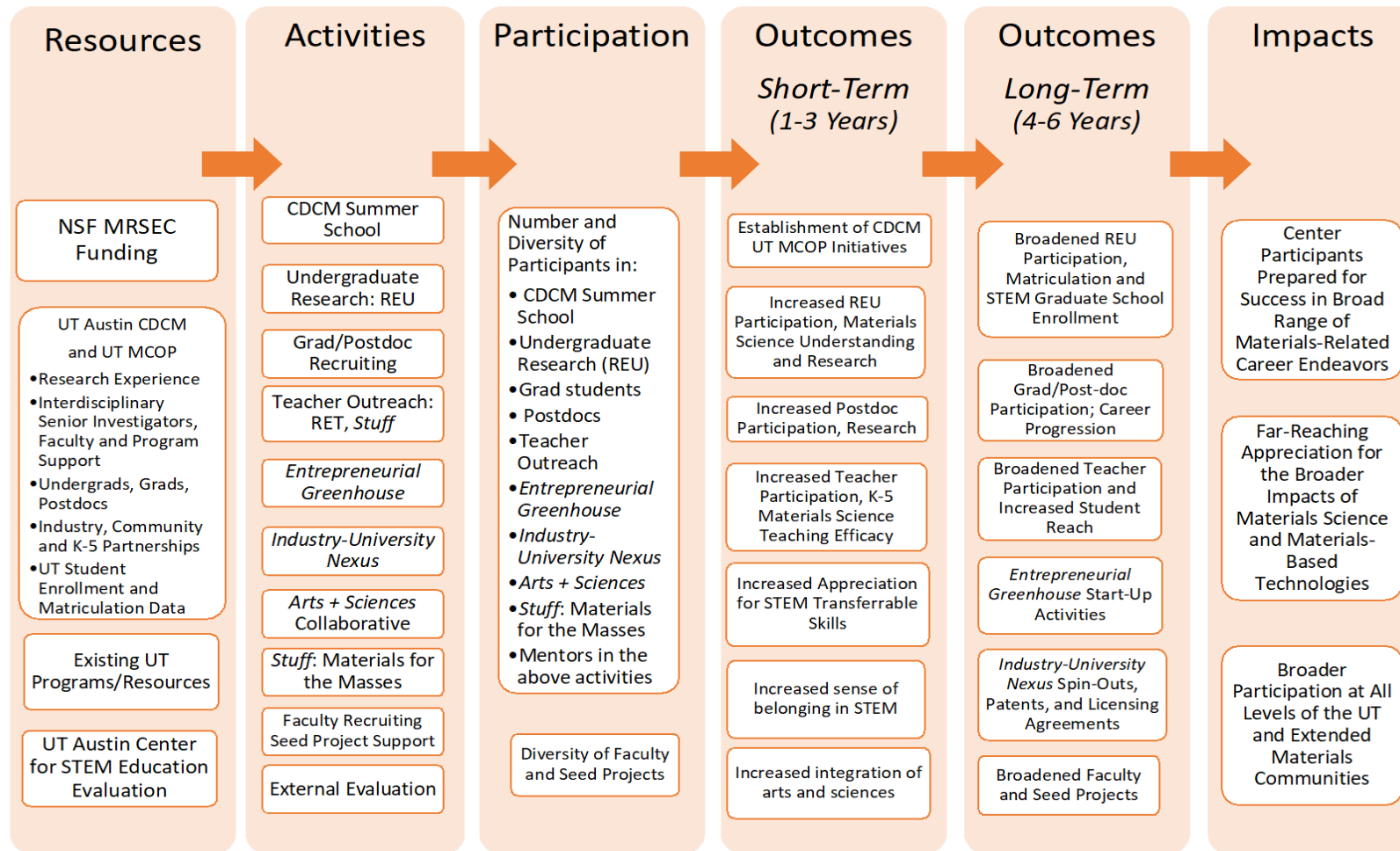
Steady flow of undergraduate and graduate engineers with key technical and professional skills necessary to transform the nascent cell manufacturing industry

A sustained ecosystem of partnerships ensures strong links among all stakeholders to address current and future needs of the cell manufacturing workforce

Instructor engagement with CMAAT at all levels is institutionalized, becoming an exemplar for infusion of cell manufacturing concepts into engineering education at all levels



Logic Model for MRSEC CDCM Education and Outreach Evaluation





Outputs vs. Outcomes and Impact



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