Establishing a New School at W&M

Intended Purpose:

This document should be viewed as a **draft,** to initiate the discussion process.
Initial circulation is to the "Design Work Group" and the three directly involved Departments/Units, to collect their comments/suggestions as part of an iterative refinement process that will eventually include broader constituencies of the W&M community as appropriate.

<u>EXECUTIVE SUMMARY</u>

Goals
- Maintain and expand W&M's excellence in teaching and research in the rapidly evolving fields of computer science, data science and the applied sciences
- Provide world-class, well-funded graduate research programs, which in these fields is necessary to maintain cutting-edge undergraduate programs at a level commensurate with W&M's standing
- Increase our ability to attract and retain exceptional faculty, staff and students
- Expand the level of visibility, research, national attention and external funding in those fields

Proposal
- Create a new more autonomous academic entity including computer science, data science and applied sciences as initial core departments/programs.
- Maintain and expand collaborations between the new entity/new school and other university units through core membership and flexible affiliation by individuals or program clusters

Why are those goals important?
- Meet expanding student interest
- Provide better preparation to students for career opportunities that build on competence in those fields
- Those fields have expanding impact on research and teaching in several areas of Arts and Sciences, as well as connections to VIMS and the Business, Education and Law schools
- Research excellence in those fields enhances the university's recognition and attracts outstanding faculty and graduate students
- Research excellence in those fields will have a direct impact on the quality of undergraduate teaching, and thus can help us attract better undergraduate students

Why is a more autonomous entity required to achieve those goals?
- There is a clear trend in these fields at other universities with which we compete for students, faculty and funding, and it has become an important indication of institutional commitment
- W&M's growing interest and strengths in these areas does not have the external recognition it deserves, in part because the effort is distributed across multiple units within Arts and Sciences
- Policies and procedures that may be best for all disciplines taken together understandably limit the flexibility to deal with the special needs of individual disciplines. That is not unique to these fields, but it is an impediment in meeting the demands of rapidly evolving disciplines.

Does the autonomous entity have to be a new school?
- A new school would best meet the goals, although it would have additional administrative costs and consequences for the remaining arts and sciences units that would have to be considered, particularly in terms of resource allocation
- An institute could promote research, but it could not grant degrees

RATIONALE

The move towards the proposed New School is in response to the following::

- Clear disciplinary trends

- The need to grow and retain a robust faculty body in a competitive environment

- Meeting increased student demand for these programs

- Availability of dedicated state resources

- The potential to better serve our students by blending graduate and undergraduate education at a scale higher than an individual Department

- The potential to elevate our national profile in research and student recruitment

- The potential for improved connections with a robust industry sector

- The potential to scale up DEI activities.

Below we briefly address these issues in the context of our move to establish the New School.

Response to clear disciplinary trends:

There is a clear trend in academia towards establishing schools of computing as vehicles for the disciplines that are expected to comprise the proposed new school. A simple Google search with the keywords "school of computing" results in 614,000,000 results in 0.91 seconds. In the 2022 US News graduate rankings of Computer Science programs, for the top 103 programs, only 15.6% are in Arts and Sciences (this includes CS@W&M, ranked 69), 26.4% are in Schools/Colleges of Computing, 54% in Engineering Schools, and 4% in College of Sciences.

Some examples include:

- The [School of Computing and Information](#) at the University of Pittsburgh, comprising the Departments of Computer Science, Informatics & Networked Systems, and Information Culture and Data Stewardship.

- The [College of Computing](#) at Georgia Tech, comprising the Schools of Computing Instruction, Computational Science and Engineering, Computer Science, Cybersecurity and Privacy, and Interactive Computing.

- The [Faculty of Computing and Data Sciences](#) at Boston University, aggregating the Departments ofComputer Science, Electrical and Computer Engineering, Mathematics and Statistics, with programs in Information Systems, Biostatistics, Bioinformatics, and Emerging Media Studies.

The computing field is also moving in that direction even within the Commonwealth, in anticipation of competition for future resources:

- The [School of Computing](#) at George Mason University, comprising the Departments of Information Sciences and Technology, Computer Science, and Statistics.

- UVA's [School of Data Science](#)

- JLab recently developed a Data Science division in addition to its IT and High-Performance Computing divisions and is pursuing the development of a Cloud-based Data Center.

Likewise, the exponential growth of new research directions in the domain of biomaterials and biomolecular engineering (synthetic biology), has stimulated the development of Applied Science undergraduate course offerings in these areas. An example of biomolecular engineering is the biological "machine" (often bacteria) that has been genetically engineered to replace or improve standard manufacturing processes ranging from food and fiber production to sensors and effectors for a myriad of physical, chemical, biological and medical states. At William and Mary, we have begun to address the substantial increase in student awareness and demand for coursework in these emerging domains. Currently students in restricted numbers are taking courses in both the biomaterials and biomolecular domains (including the iGEM International competition, since 2015) that unfortunately have been limited by the small number of Applied Science faculty and Affiliates who are available to offer courses. Our plans for the New School involve expanding an undergraduate and graduate program and course opportunities in the bioengineering domain, perhaps even including a Major in Applied Science.

A primary objective of the Applied Science department within the proposed New School will be to establish and expanded new interdisciplinary collaborations with William and Mary colleagues across all departments and schools to further a broad spectrum of research at both the undergraduate and the graduate level. We envision welcoming faculty from across the University to become department affiliate members and possibly primary advisors for their students in one of the many Applied Science PhD tracks.

Building a robust and sustainable faculty body in a very competitive talent market:
Faculty recruitment will benefit from a new school. Recruiting new faculty in CS/DS faces a dramatically competitive academic job market for faculty hiring. Computing job announcements at https://cra.org/ads/ provide a bird's eye view of the difficulty to hire: there are *many* faculty positions, and many universities are recruiting in bulk; multiple open positions are the new norm, with peer universities advertising cluster hires that often comprise as many as 10+ positions (including Princeton, Cornell, Michigan, Tufts, Texas A&M, UCLA and many others).

The New School will position W&M well within the national academic landscape, making us more competitive to attract top candidates. In the 2021-22 academic year, we lost candidates who preferred departments that were in more growth-friendly environments, i.e., within schools/colleges of computing, or in engineering schools.

Beyond hiring exceptional faculty, the New School will help the participating units to better sustain growth and improve the resilience of the involved programs by counteracting faculty

attrition because of the aforementioned very competitive academic job market. For example, every tenured faculty in Computer Science who was hired after 2004 has received a CAREER award. Yet, the CS department has lost 6 of these CS faculty (two of them were recipients of both NSF and DOE CAREER awards) because they were heavily recruited by bigger programs with a wider computationally related mission. We are confident that the New School will attract (and retain) top-quality faculty as well as graduate students to our programs.

Meeting increased student demand:

A robust faculty body is necessary to meet the rapidly increasing teaching demands placed on our faculty and to better serve students in A&S. For example, the CS department offered 824 seats in the 2012-13 academic year. Ten years later, in 2021-22, it offered 2119 seats, a growth of 250%. However, during the same period the number of faculty increased by less than 50% and the number of teaching assistants remained the same. The teaching pressure continues to increase each semester in the foreseeable future. This demand is fueled by the increased size of incoming classes at W&M and the rapidly expanding requirement to provide computational and data literacy to W&M students as one of the targets of Vision 2026. To meet such demand, we must offer more sections of our courses and further increase the diversity of the subject matter relevant to an increasingly broad range of disciplines. Both solutions require an increase in faculty and graduate student support resources than is presently available (e.g., research funding and dedicated state funds for workforce development) offers a strong potential to meet this need in a cost-neutral mode for our university.

A robust faculty body will also allow us to develop more exciting cross-disciplinary endeavors with A&S or the Business and Law Schools (e.g, programs in Computational Social Sciences, Computational Linguistics, Cybersecurity, or Digital Literacy across various A&S domains). We will be able to offer new, exciting majors in collaboration with departments in A&S. For an important example please see an example of a new major across a School of Computing and English at the University of Pittsburgh:

https://www.sci.pitt.edu/academics/undergraduate-majors/digital-narrative-and-interactive-design

In light of the above, the New School will allow us to grow at a scale commensurate with the demands of our undergraduate and graduate students

Improving our ability to obtain dedicated state resources:

Both CS and DS have grown over the past few years without any substantial use of W&M resources, using instead dedicated state resources for this growth. CS has been supported through the Tech Talent Pipeline (TTIP program), and DS through dedicated Data Science investments from the Commonwealth for high demand degrees. Therefore, the growth of

these programs has not negatively affected the availability of W&M resources to other units; if anything resource opportunities have improved.

While the receiving money from state sources has been successful, the fact is that we have received less resources from the same external state programs than other Virginia Universities because we are not viewed as *sufficiently tech-oriented* by the Commonwealth. From the 11 Virginia Schools that secured money from the TTIP program, W&M received the least money per B.S. promised degree (a spot shared with James Madison, well below Radford, CNU, and ODU). Other programs received between 20% and 60% more than us per promised BS degree. This has cost us millions that would otherwise have supported our further growth.

In light of the above, the establishment of the New School will allow us to raise our visibility and become more competitive in pursuing such external resources.

Blending graduate & undergraduate mission at a scale higher than a single Department, to better serve our students:
The units that will encompass the New School have a clear graduate mission to complement our well-established undergraduate one. High quality, externally funded research and the production of high-demand, high quality graduate degrees (MS and PhD) will be an integral part of the School's mission. This is a necessity: in rapidly evolving fields such as CS, DS, and AS, research excellence is *necessary* for excellence in undergraduate teaching, that needs to be continuously evolving to incorporate the latest and greatest. Furthermore, a new school with our particular focus will serve as a unique opportunity to establish new norms that facilitate the types of academic inquiry and pedagogy prevalent at "R1" institutions, bringing international attention and external funding not just to the School itself, but to William & Mary more broadly.

In light of the above, the strong graduate education component of the New School's mission will elevate our undergraduate offerings as well and could offer a new paradigm for other programs too.

Potential to elevate our national profile in research and student recruitment:
Currently, both CS and DS are very small in comparison to other CS and DS programs in the nation. Thus, even though we have pockets of excellence, and we are outperforming almost all other comparable programs in the Commonwealth *per capita* (e.g as easily shown in a quick search at SciVal), we have been unable to translate individual accomplishments into Center-level recognition (incl. a Cybersecurity Center). The New School will allow us to plan for focused growth. It will be a natural environment to foster improved collaboration among its members and build the broad resident expertise required for applying for large scale grants from federal agencies.

We will also be able to rank competitively for specific undergraduate and graduate programs in US News & WorldReport where the size of the faculty for specific programs plays a tremendous role. The CS current ranking of its graduate program is US News has remained at the same level in the past two ranking cycles, with the undergraduate ranking fairing similarly. This is a great achievement because we are the smallest department in our ranking class: other programs ranked together with our CS are double or triple our size. The anticipated growth will help us rise in ranks, which in turn will make us more competitive when it comes to student recruitment.

In light of the above, the establishment of the New School will elevate our national profile, allow us to improve our rankings, and will allow us to improve student recruitment in our programs.

Potential for improved connection with a substantial and rapidly growing industry sector: The departments that are the core of the New School offer BS (CS and DS) and MS/PhD degrees (CS and AS, and DS through AS). The creation of this school will give the opportunity to create professional MS programs (similar to the Business School) as other Schools of Computing and Data and will attract a graduate student body that is not currently possible within the A&S confines. The CS department is already participating in a national consortium for [creating pathways for non-CS majors to pursue a MS degree in CS](#), and CS and DS have jointly developed a Graduate Certificate program in response to industry needs.

These needs are growing and evolving, often residing across the CS-DS spectrum (as firms with strengths in one part of that spectrum try to become competitive in the other), and to meet these needs we need a vehicle like the New School, that brings together our experts. This is part of the motivation for the nationwide trend of developing large scale Schools like ours, as mentioned in the first paragraph of this section. The industry footprint of the New School is one of the fastest growing segments of the economy: DS jobs remain the hottest jobs in the market (see [Harvard Business Report](#)), and the DS market is expected to [grow to well over 300B](#) by the end of the decade.

In light of the above, the establishment of the New School will serve a broader strategic goal for our University, as it will serve as a gateway into an already substantial and rapidly growing business sector.

Scale-up/leverage of existing DEI activities:
William & Mary has a tremendous advantage in attracting underrepresented groups in the sciences, especially women. Currently, 34% of the undergraduate CS population are women (national average is 22%) and is a much higher share than in other VA schools (at VA Tech for example, the share of women in CS is only 14%). The new school will leverage and scale up existing departmental activities that encourage the creation of an even stronger community for underrepresented groups and especially women in computing, data, and applied sciences. It will also serve as a hub for our outreach activities to foster the recruitment of minority students

and faculty, by having a research profile comparable with our competitors (see earlier section regarding the establishment of similar schools at Mason and UVA).
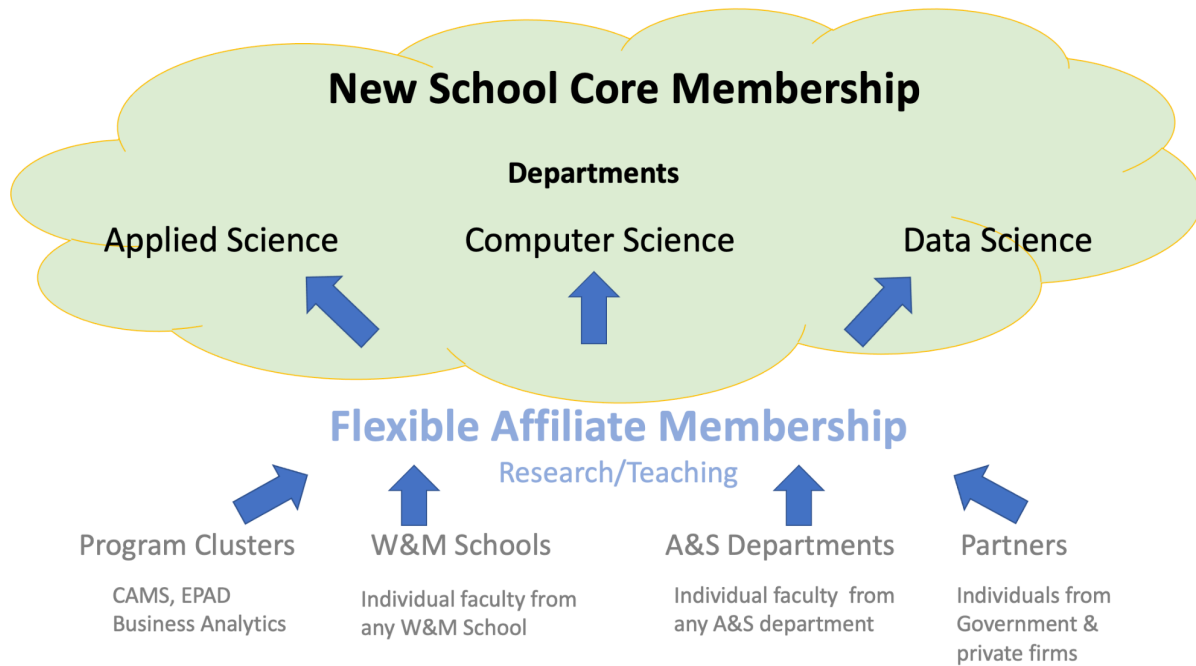
MEMBERSHIP

The principle behind the establishment of the New School comprises two key components:

- enabling the ability of its core units to grow, and

- maintaining or even growing collaborations between New School units and university-wide units, in support of our educational and research activities.

In order to meet these principles, we envision a combination of *core* and *flexible* affiliation for the New School. Core affiliation refers to the three departments that are a natural fit to become the core of the New School, and are three of the four PhD-granting science departments at William & Mary: Computer Science (CS); Data Science (DS); and Applied Science (AS). Flexible affiliation refers to a pool of individual affiliates (or affiliated program clusters) whose academic home remains outside of the New School, but with a strong collaborative portfolio that intersects with the New School's mission, either in teaching (Teaching Affiliates) or in research (Research Affiliates). Figure 1 captures this notion of core membership and flexible affiliations.

Figure 1: Envisioned membership and affiliation levels for the New School

Table 1: High-level governance model for the New School

	Rights and Privileges	New School Faculty		Affiliates
		Dept-level	School-level	
Faculty				
Personnel issues	Vote on appointments, tenure/promotions, selection of affiliates, selection of search committees	Yes	No	No
Searches	Eligible to serve	Yes	Yes	Yes
Academic				
Curriculum	Vote on new courses, programs	Yes	Yes[1]	No
Grad Admission	Admit new grad students	Yes	No	No
Instruction	Teach courses	Yes	Yes	Yes
Honors Thesis, MS Thesis, PhD Dissertation	Serve as primary advisor	Yes	Yes	Yes
	Serve as committee member	Yes	Yes	Yes
Research				
Externally funded research	Maintain a research lab leading to doctoral degrees	Expected		
Proposal routing	Submit proposal through New School and manage expenses	Mandatory		No
Research Infrastructure	Access to shared labs and computing resources of New School	Priority		On need basis
Recognition				
Website	Identified in New School website as core member or affiliate	Yes (core)		Yes (affiliate)

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[1] We envision this school-level activity to be carried out by corresponding committee(s).

In Table 1 we present an early outline of the governance model for members and affiliates of the New School, and relevant key issues/processes (i.e., personnel, academic, research and recognition). The columns convey the following:
- *First column*: various governance-related activities;

- *Second column:* corresponding rights and privileges;
- *Remaining columns:* whether these rights are afforded to members of one particular Department of the New School (*third*), or shared with the other two Departments of it (*fourth*) and the New School affiliates(*fifth*).

For easy visual reference, segments where such rights are afforded are marked as green cells.

The fundamental principle is that Departments within it are afforded independence to grow within an **agile operating model**, to allow its components to operate and grow at a faster pace while pursuing excellence in their rapidly evolving fields.

NEXT STEPS

The creation of a New School offers an exciting opportunity to grow our institution in the rapidly evolving fields of computer science, data science, and applied sciences. During the exploration process, we need to address (in addition to other issues) merger and partition logistics. **Merger logistics** are the ones referring to the operational details of the new School (e.g., student admission, operational structure, personnel policies). **Partition logistics** include a sustainable allocation of resources for the New School, to provide an appropriate operational budget, without hampering the A&S budget nor the members of the New School. The partition logistics will also include plans for a continued collaboration between the new School, A&S, the School of Business, and other Schools on campus. In order to facilitate the process, we propose the assignment of an acting **Exploration Director** to coordinate the merger and partition logistics.

Merger logistic details to consider:
student admission
· Undergraduate student admission will be to Arts & Sciences. Students may declare an undergraduate major in [AS,] CS, or DS after completing (**39** credits, current A&S practice).
· Graduate Students will be admitted directly to the three departments in the New School (in coordination with an admissions office in the new school).

operational structure
· Home Department structure is maintained for those in AS, CS, and DS. These departments report through a department chair to a proposed New School Dean who in turn will report to the Provost. The New School Dean will be selected in a nation-wide external search.
· Affiliated faculty in all other Arts & Sciences departments and W&M Schools will retain their home department affiliations and established reporting structures. The department of affiliation will be responsible for responding to home departments requirements &/or request for merit and other evaluations for the affiliated member.

personnel policies
· W&M Faculty Handbook and Provost office directives will continue to govern faculty policies.
· The New School may develop some operational guidelines related to cross-department initiatives; however, the three departments will maintain their own personnel policies.

Partition logistics to consider:
· Develop a mechanism for the sustainable distribution of resources for the New School including an appropriate operational budget and the appropriate sharing of grant-generated IDC (overhead) recovery.

· Plans for resource partitioning for all collaborations between faculty in the New School, and faculty in A&S, and all other W&M Schools.
· Plans for resource recoveries from contracts with external partners.

Appendix I.

Glossary and brief definitions of terms (from Wikipedia).

Computer science is the study of computation, automation, and information.[1] Computer science spans theoretical disciplines (such as algorithms, theory of computation, information theory, and automation) to practical disciplines (including the design and implementation of hardware and software).[2][3][4] Computer science is generally considered an area of academic research and distinct from computer programming.[5]

Applied science is the use of the scientific method and knowledge obtained via conclusions from the method to attain practical goals.[1] It includes a broad range of disciplines such as engineering and medicine. Applied science is often contrasted with basic science, which is focused on advancing scientific theories and laws that explain and predict events in the natural world.

Computational science and engineering (**CSE**) is a relatively new discipline that deals with the development and application of computational models and simulations, often coupled with high-performance computing, to solve complex physical problems arising in engineering analysis and design (computational engineering) as well as natural phenomena (computational science). CSE has been described as the "third mode of discovery" (next to theory and experimentation).[1]

Data science is an interdisciplinary field that uses scientific methods, processes, algorithms and systems to extract or extrapolate knowledge and insights from noisy, structured and unstructured data,[1][2] and apply knowledge from data across a broad range of application domains. Data science is related to data mining, machine learning and big data.[3]

Data science is a "concept to unify statistics, data analysis, informatics, and their related methods" in order to "understand and analyze actual phenomena" with data.[4] It uses techniques and theories drawn from many fields within the context of mathematics, statistics, computer science, information science, and domain knowledge.[3] However, data science is different from computer science and information science. Turing Award winner Jim Gray imagined data science as a "fourth paradigm" of science (empirical, theoretical, computational, and now data-driven) and asserted that "everything about science is changing because of the impact of information technology" and the data deluge.[5][6]

Computing is any goal-oriented activity requiring, benefiting from, or creating computing machinery. It includes the study and experimentation of algorithmic processes, and development of both hardware and software. Computing has scientific, engineering, mathematical, technological and social aspects. Major computing disciplines include computer engineering, computer science,

cybersecurity, data science, information systems, information technology and software engineering.[2]

Appendix II.

The basic profiles of the three Departments that will be the core units of the New School.

Applied Science:

● since 1995 a graduate interdisciplinary department currently with Minors in Bioengineering and Materials Science & Engineering
● with funded research programs that span the STEM disciplines, including applied mathematics, biophysics, biochemistry, data science, neuroscience, materials science, and engineering.
● has pioneered cross-disciplinary activities at William & Mary, especially with STEM programs, including Neuroscience (NSCI), Computational & Applied Mathematics & Statistics (CAMS), Engineering Physicsand Applied Design (EPAD), and Data Science (DATA).
● provides a vehicle for any William & Mary faculty member to sponsor a PhD student in one of currently 22 specialization Tracks

Computer Science:

● since 1985 has been home to a strong undergraduate and graduate program offering BS, MS, and PhD degrees. The approximate number of degrees awarded per year are 95 BS, 20 MS, and 8-12 PhD

● home to a vibrant undergraduate population with several active student clubs, including the student chapter of the Association for Computing Machinery (ACM) and the Society of Women in Computing (SWC). The SWC activities have been distinguished twice with International Recognition (ACM International Community Outreach Award).
● undergraduate and graduate populations are highly sought after employers (Northern VA and Big Tech for our BS and MS students, R1 universities and BigTech for our PhDs).
● faculty are distinguished by excellence in their respective fields as illustrated by the numerous CAREER awards within the department, the US News ranking (CS is the highest-ranked graduate department in the Sciences within W&M), and csrankings.org which allows for computationally driven ranking with specific fields. CS national rankings are incredibly high given its small size.

Data Science:

● started in 2016 as a self-designed interdisciplinary major, with a formal minor added in 2017, a B.S. degree in 2020, and established as an independent unit in 2022.
● serves a vibrant undergraduate population currently graduating 40 majors per year, and growing
● comprises accomplished researchers, with expertise on broad issues ranging from the intersection of data and society to machine learning applications in fields like satellite imagery analysis and nuclear physics experiments,

- currently collaborating with Computer Science in a graduate certificate, with Applied Science in a DataScience PhD track, and with numerous other A&S programs through affiliate faculty.

Appendix III.

A Brief Timeline of Preliminary Discussions/Activities:

2019:

- **10/2019:** Data literacy proposal by Student Government (Abhi Chadha, Raman Khanna, Clara Waterman; Student Assembly, Academic Affairs).
- **11/2019:** Initial discussions with CS faculty that introduced the idea of pursuing a School of Computing

2022:

- **4/ 6**: Meeting of Peggy Agouris and Dennis Manos with Dr. Azer Bestavros, Vice Provost for Computing and Data Sciences, Boston University
- **4/25**: Meeting of Provost's Executive Team with Dr. Azer Bestavros, Vice Provost for Computing and Data Sciences, Boston University
    - o **Provost's Executive Team members** (at the time): Peggy Agouris, Dennis Manos, Steve Hanson, Martha Wescoat-Andes, Sallie Marchello, Maria Donoghue Velleca, Ben Spencer, Larry Pulley, Rob Knoeppel, Derek Aday, Carrie Cooper
- **5/3**: Provost assembles an *ad hoc* **Design Work Group** to explore the idea of a new entity in Computing, Data Science and Engineering (CDSE)
    - o **Design Work Group members:** Maria Donoghue Velleca, Silvia Tandeciarz, Steve Hanson (has since stepped down and is replaced by David Yalof), Rob Knoeppel, Derek Aday, Joe Wilck (has since left W&M, now replaced by new dean Todd Mooradian), Iria Guiffrida, Evgenia Smirni, Eric Bradley, Martha Wescoat-Andes (Fred Corney was also invited but declined)
- **5/24**: Meeting of **Design Work Group** with Kennedy Group consultants
- **6/6**: Meeting of **Design Work Group**
- **6/23**: Meeting of **Design Work Group** – decision made to turn it over to the three academic leaders (Evgenia Smirni, Eric Bradley, Tony Stefanidis) to work on a proposal from the two departments and one program that are interested in this.
- **8/3**: Initial meeting of Smirni/Bradley/Stefanidis(followed up by several meetings)
- **8/9**: Meeting of **Design Work Group**
- **10/4 and 10/11:** Provost meets with FAS (zoom) and Faculty Affairs Committee (in person)
- **10/11:** Delivery of initial exploratory document
- **Week of 10/10 and 17:** Discussions with AS/CS/DS faculty members, and with the design team
- **11/6:** Update of initial exploratory document to reflect feedback up to that point