#1907

NDSU Student Technology Fee Action Plan Request

I. Action Plan Introduction and Authorizations

NDSU ORGANIZATION OR UNIT NDSU Information Technology Division			
TITLE OF PROJECT **Cloud computing services for NDSU Education & Research**			
Project Duration (3 years maximum)	**From: July 1, 2019**		**To: June 30, 2020**
Type of Project (Check one)	**New X**	**Previously Submitted**	**Renewal**
Total Technology Fee Request $ 25,000			
Project Director **(Must be NDSU faculty or staff)** Kim Owen	**Campus Address: NDSU Dept 4500, PO Box 6050, Fargo, ND 58108-6050** Phone: 701-231-9522 Fax: 701- 231- 8541 E-mail: kim.owen@ndsu.edu		
Name (Type or Print)	**Signature**		**Date**
Project Director Kim Owen, Program Manager Research & Education Network Resources NDSU	Kim Owen		2019-02-15
IT Division Consultant Steve Sobiech Assistant Vice President for Enterprise Computing and Infrastructure NDSU	**Signature** SS		**Date** 2/14/19

Executive Summary (maximum of 175 words) Describe in 175 words or less the technology need that is being addressed, how it will be addressed, and the expected outcome.

Executive Summary (maximum of 175 words) Describe in 175 words or less the technology need that is being addressed, how it will be addressed, and the expected outcome.

This application requests funding for a one-year subscription to Azure cloud computing services for use by students, faculty researchers and staff. The resources will be for classroom, field experience and internship activities initially within two programs; Precision Agriculture and Health Professions. Staff from IT/CCAST will dedicate efforts to provide support for these resources. Project outcomes of increased knowledge and skills by all users will support future use in other disciplines.

This proposal addresses a critical need to ensure the security and privacy of participants and their data, and to expand remote access and management of project data regardless of proximity to campus. Additionally, the project includes external partners whose personal data and intellectual property must be protected as they share applications and protected source code for project activities.

A primary driver of this project involves a partnership between NDSU's Precision Ag program and Microsoft to test product features for Precision Ag. The use of Microsoft services will be dedicated to education and research activities for a specific time period and will not duplicate existing services.

The Technology Fee Advisory Committee will only accept for consideration Student Technology Fee Action Plan Request forms which are fully completed and signed, and whose Project Directors have no past due reports on previously awarded projects as of the current submission deadline date, according to the guidelines listed in the Instructions, pages 1 and 2.

Technology Action Plan Request forms will be opened and reviewed after the submission deadline.

NDSU Student Technology Fee Action Plan Request

II. Project Overview

1. How does this project meet student needs?

Integration of advanced cloud computing services and related applications will benefit students in programs across campus, initially in those departments previously mentioned, and in the future as use expands across other disciplines. This proposal lays the groundwork for NDSU student access to Microsoft Azure services in much the same way they have access to Google services today. It will include access to a large portfolio of Azure services for instructional purposes, individual study and research, and personal purposes.

Successful results from the testing and deployment of these resources will allow NDSU to better serve students, faculty and staff regardless of where their classes or field experiences are located.

Specific to the Precision Ag program, outcomes of this project will benefit NDSU students by increasing our institution's ability to equip current and future ag producers and ag industry workforce with the technology and data analysis skills required to speed adoption of Precision Agriculture techniques. The launch of the new Precision Agriculture program addresses a pressing need in the region for a workforce skilled in the fast-changing environment of precision agricultural technologies.

Another outcome will be the benefits to student experiences in research that will be enabled by the improved capabilities included with Azure as it applies to various departments across the College of Health Professions. NDSU's expanding focus on medical related fields increases the need for computational resources able to support the needs of restricted medical data. This project will leverage the Azure certified computing platform that allows for secure storage and computation on regulated access data like personal identification information, HIPAA regulated data, credit card information, etc. No such platform currently exists at NDSU and by connecting to Azure we'll provide the ability to perform such research long before it would otherwise be possible.

Similarly, there are other resources provided through Azure that will be available at production quality that otherwise are not currently available to the NDSU community.

While the programs described in this proposal have either been recently deployed, or close to starting, they are in many ways still in the early stages of development and as a result, do not have hard budget numbers in place for many of the technology resources needed. Project development and negotiations for technology resources are ongoing at the time of this proposal submission. We anticipate many changes in the months to come and even more as the next year of activities is launched. Therefore, the budgeted expenses are estimated based on the most current information at this time. If the proposal is awarded at the full amount and ultimately requires less funding than awarded, the remaining funds will be returned to the TFAC fund. Alternatively, if the proposed budget is short of the full amount needed, the remainder will be covered by project partners.

2. What audience does this project directly serve? What audience is indirectly served? How many students are affected?

Successful results from the testing and deployment of the proposed Azure cloud resources will allow NDSU to better serve students, faculty and staff regardless of where their classes or field experiences are located.

Directly served: Initially the primary target audience benefitting from the addition of these resources includes the students and research faculty of programs in Precision Agriculture and Health Professions. Those students and faculty involved in multi-campus collaborations will also be directly impacted through cloud access to data, analytics and computation resources relevant to their field experiences and internship activities. The number of anticipated users across the Health

Professions field is more difficult to determine at this time. However, leadership across four different Health Professions fields indicate a strong interest in access to these resources for management and analysis of restricted medical data sets.

Indirectly served: In alignment to NDSU's mission as the land-grant institution for North Dakota, research partnerships and dissemination of project results will directly benefit those across the agricultural industry, including growers and industry services, since research field experiences within this project will be conducted at several of NDSU's Research Extension Centers across the state.

The number of students, faculty and researchers benefiting from the projects described here will continue to expand each year, and extend to other disciplines and departments. Early estimates for undergraduate and graduate students, faculty and researchers in the Precision Ag program for this first year are estimated at more than 60. This count does not include use by external partners who will be part of the research activities, where participating ag producers and ag services industry partners are estimated to be over 100. For the Precision Ag program, the fall semester of 2019 marks the formal launch of the new program so it is anticipated that numbers will increase with each year, and even each semester. Students will continue their access and increase their engagement in Azure resources across the lifetime of their enrollment in undergraduate and graduate programs at NDSU.

3. For projects that target a subset of NDSU's students, please describe the possibility for broader application in the future.

Outcomes will result in broad benefits across campus, where the knowledge and skills gained by students, faculty researchers and IT staff alike will serve to increase NDSU's ability to support advanced and specialized technology tools in academics and research activities.

Key to the value and effectiveness of this project will be the expanded knowledge-base and skill sets achieved by all users and support services. The ability to test and refine applications and data flows on a smaller group of initial projects will enable and expedite the transfer of that knowledge to support programs across the institution.

4. Describe both the immediate and long-term impact of this project.

This proposal lays the groundwork for NDSU student access to Microsoft Azure services in much the same way they have access to Google services today. It will include access to a large portfolio of Azure services for instructional purposes, individual study and research, and personal purposes.

As stated above, the ability to provision and deploy these services to a subset of constituents on campus will benefit the institution as a whole in the long term as additional end users adopt the services and continue to build on the capabilities of these tools in ways that support specific disciplines. For central and distributed IT staff, and CCAST staff, the support provided by Microsoft to work in tandem with NDSU to prepare and deploy these resources provides additional benefits in both the short and long term, as this model ensures improved skill sets by support systems (IT and CCAST) for the benefit of the end user, all specifically targeted at use within a higher education research institution.

5. Who will pay for ongoing expenses following the technology fee funded portion of this project (e.g., who will replace hardware or software after it has reached its end of life)?

This application requests assistance to purchase a one-year license for Microsoft Azure baseline services and additional specialized components as needed. Efforts to secure the funds needed for this first year are led by IT, CCAST and the College of Agriculture Agricultural and Biosystems Engineering. Additionally, preliminary discussions between the leadership in the College of Health Professions, IT and CCAST indicate a strong interest in cloud computing resources for medical data that support the restricted computing domain. They understand these resources come at a cost to the institution and intend to continue negotiations with IT and CCAST to determine the level of support needed.

Licensing costs for these projects will extend beyond the scope of this first year of the Microsoft partnership, with a potential of up to three years to cover the full Microsoft project. It is the intent of the organizers to identify sustainable funding that can continue to support this license as its use expands within this project and to other departments across campus.

The hardware needed to support Azure Cloud services is already in place within central IT and CCAST. No additional hardware costs are anticipated. IT and CCAST staff will provide initial setup and provisioning of services, in addition to reasonable ongoing support as the project moves forward. No additional costs for salaries or fringe benefits are requested.

Software and specialized Azure components needed for this project will be addressed in one of two ways: a) additional Azure components can be added to the baseline license in a 'buy as you go' model and will continue to be covered in part by the departments partnering in this proposal, and b) external industry partners whose applications require specialized software will provide support for additional licensing costs as needed for testing and deployment.

6. Describe how this project will follow NDSU's best practices in information technology. (Please make sure the NDSU IT Division staff you consulted signs in Part I of this form.)

The project will support best practices in information technology by addressing critical needs in two key areas as described below. In terms of compliance to industry standards, Microsoft has the capacity to address and achieve compliance standards at a level that is unlikely for NDSU to achieve at the institutional level. Additional information and details are provided below and online at https://azure.microsoft.com/en-us/blog/microsoft-azure-leads-the-industry-in-iso-certifications/

Security:
Integration of applied learning experiences with Azure cloud services will provide students with the ability to hold cloud services accounts throughout their time in program while at NDSU. Students will have user rights specific to the project and experience in which they currently work, beginning with coursework and on campus lab experiences, to summer field experiences and internships. Those same cloud services will host specialized project-specific applications provided by external industry partners where protection of intellectual property (IP) is critical. In the case of the Precision Ag project, a significant part of the research involves ag producers across the state who will be partnering with the University to conduct research on their own crops and livestock. Crop and livestock production data is regularly reported to federal agencies and any disclosure of data outside the research could place the participants at risk of financial standing and liability. Information about growers must be obtained, managed and archived in a manner that does not allow disclosure of the identity of the producer.

Data work flows
Relative to the security issues described above, the use of the cloud services provides access to specialized applications, computation and data storage from anywhere at any time. For the precision ag program, this means that students and project participants involved in field experiences can interface with data at any stage of the research data collection, computation, and archiving process regardless of their location. Students participating in field experiences where data collection takes place in fields or rangeland will be able to remotely access the project cloud in order to upload, process and manage the data in a timely manner. Relevant to the Precision Ag program, processing and analysis of data generated by crops during the growing season require immediate action by the grower in order to adjust crop management practices to achieve maximum production for that season. The capacity of cloud services to host the applications and services that make all of this data management work will significantly impact a grower's ability to improve economic benefits in their operation. This work will expand NDSU's ability to provide students and researchers with the opportunity to develop and test new and advanced applications for these purposes.

Similarly, other resources provided through Azure that will be available at production quality that otherwise would not be available to the NDSU community. These include certification for global industry standards for security compliance. Detailed information on ISO certifications for Microsoft Azure are included below and online (https://azure.microsoft.com/en-us/blog/microsoft-azure-leads-the-industry-in-iso-certifications/).

Azure leads the industry with the most comprehensive compliance coverage, enabling customers to meet a wide range of regulatory obligations". Azure has formally completed and certified their datacenters against the following International Standards; CSA STAR Certification, ISO 27001:2013, ISO 27017:205, ISO 27018: 2014, ISO 20000-1:2011, ISO 22301:2012, ISO 9001:2015. Thereby helping to ensure the security of all types of data including Research data and Research data workflows. ISO standards provide baselines for information security management that are relied upon by many other standards across regulated industries and markets worldwide.

7. What service on campus is most similar to the one proposed here? How does this project differ?

This application does not duplicate any current programs or resources available at NDSU. The ability to test and deploy Microsoft Azure specialized cloud services through these projects will improve NDSU's ability to support advanced tools available for academics and research conducted by scattered groups of scientists across NDSU.

NDSU Student Technology Fee Action Plan Request

III. Project Description (5 pages maximum)

Include information on the background of this project: how did it come to fruition?

Project background:
This application requests funding for a one-year subscription to Azure cloud computing services provided by Microsoft to be used by students, faculty researchers, and staff at NDSU. The license will be owned by NDSU and the tools and resources in the license will be available for classroom, field experience and internship activities within several programs. The two programs described in this application will be among the first to use the license to develop and test Microsoft cloud services in projects requiring specialized technology applications and tools.

Initial primary drivers of this proposal are based in two disciplines at this time. The first is within the Agriculture and Biosystems Engineering (ABEN) department where a three-year partnership between NDSU's Precision Ag program and Microsoft will test and deploy cloud services that support digital agriculture as part of the new Precision Ag program. The second project originates within the Health Professions disciplines and involves computation and analysis of large medical data sets that carry critical requirements for restricted access. Preliminary discussions between the leadership in the College of Health Professions at NDSU, IT and CCAST indicate a strong interest in cloud computing resources that support the restricted computing domain. They understand these resources come at a cost to the institution and intend to continue negotiations with IT and CCAST to determine the level of support needed.

The programs described in this proposal have either been recently deployed, or are close to starting. They are in many ways still in the early stages of development and as a result, do not have hard budget numbers in place for many of the technology resources needed. Project development and negotiations for technology resources are ongoing at the time of this proposal submission. We anticipate many changes in the months to come and even more as the next year of activities is launched. Therefore, the budgeted expenses are estimated based on the most current information at this time. If the proposal is awarded at the full amount and ultimately requires less funding than awarded, the remaining funds will be returned to the TFAC fund. Alternatively, if the proposed budget is short of the full amount needed, the remainder will be covered by project partners.

It is the intent of this proposal to request funding for the first year of a license for Microsoft Azure cloud services. Licensing costs for these products will continue on an annual basis. During this first year, efforts will continue to develop a funding source to sustain ongoing licensing costs in future years. The Microsoft partnership with ABEN is planned for a three-year period beginning in FY20. For each of the programs described here, the use of Microsoft services will be dedicated to the coursework and research activities for that program for a specific time period and will not duplicate existing services.

The momentum by Colleges and departments across NDSU in the development of new program offerings focused on specialized topics continues to expand. These programs require increasingly advanced research practices and tools. Students in these programs benefit from early and sustained engagement in their program's research experiences making them a valuable asset to businesses and industry who seek highly qualified and skilled graduates. Specific to technology, as NDSU works behind the scenes to improve the support services critical to the needs of these new programs, every improvement generates a ripple effect of benefits to programs across campus where the increased skills and knowledge base acquired by support services such as IT and CCAST serves to strengthen the value of these specialized resources for the whole institution.

The request for funding in this application carries this same potential. In the world of cloud services, Microsoft's Azure cloud platform is quickly rising to a position among the leaders of cloud service providers around the globe. To fully benefit from the value of Azure services, both the platform itself and the services that use the platform to function must be understood and deployed in a way that best serves the university-based education and research projects described in this application. For example, a primary goal in Microsoft's partnership with the Precision Ag program is to use this

opportunity to test and deploy Azure services that can benefit the global digital agriculture industry, where implications for its use extend far beyond NDSU's College of Agriculture and the Research Extension Centers in our state.

Supporting annual costs for specialized technology tools like those proposed here will require development of a plan for funding these needs going forward. Similar to these projects, needs arise before long term funding is in place. This proposal requests funding to purchase one year of Microsoft Azure cloud services along with needed applications and services in order to enable the launch of new programs, while at the same time provide additional time to refine plans for deployment and funding sustainability.

While the discipline specific programs highlighted in this application have surfaced as the initial drivers for the need for these resources, it has become evident in recent months that several other departments are already conducting development and testing of some of these resources and are interested in increasing the use of these tools. All of this serves as a clear message to Information Technology that more work will be needed by IT support services to ensure readiness by both program faculty and researchers, along with supporting IT units to provide both access to the specific types of resources needed, and to have staff who are well-informed, knowledgeable and skilled in the use of these advanced tools for both coursework and research related field experiences.

The technology need and how it will be addressed:
Dedicated access to the Microsoft Azure cloud platform and how it interfaces with the specialized applications required in the precision agriculture and health industries will give end users and the supporting IT/CCAST staff the ability to build and deploy the cloud services in ways that best meet these needs. Resources provided through Azure will be available at production quality that otherwise are not currently available to the NDSU community. Staff from IT/CCAST and the distributed IT staff in the departments of ABEN and Health Professions will dedicate efforts to the project to provide support for these resources. Project outcomes of increased knowledge and skills across IT staff will support future use in other disciplines.

Many classroom, lab and field experiences in the projects described here and those in other disciplines are critically dependent on the ability to ensure the security and privacy of research participants and their data. Applied learning experiences in these programs occur in a variety of locations on and off campus so it is important to have the ability to access and manage data regardless of proximity to campus. External partners from the industry, and individual research participants such as farmers and ranchers also play a significant role in these projects. It is NDSU's responsibility to ensure that the timely transfer and management of personal data and intellectual property is protected when these partners share personal information, newly developed software applications and protected source code for project activities.

The outcome once the need is addressed, and the number of students that will benefit:
Initial results will be evident early in the project year as a result of a collaborative project team that will focus on dedicated training, testing and deployment of specialized Azure services and applications chosen to support the Precision Ag and Health Professions programs. These include the increased understanding and skills of students, faculty researchers and staff in utilizing cloud service technologies in ways that support their specific education and research areas. No less equal in value will be the increased knowledge base and skill sets gained by IT and CCAST staff, as well as department level IT staff aimed at improving the support system for these advanced services. The integration of Azure cloud services and relevant components will improve capabilities by NDSU for management of data across the research data life cycle.

The number of students, faculty and researchers benefiting from the projects described here will continue to expand each year, and extend to other disciplines and departments. Early estimates for undergraduate and graduate students, faculty and researchers in the Precision Ag program for this first year are estimated at more than 60. This count does not include use by external partners who will be part of the research activities, where participating ag producers and ag services industry partners are estimated to be over 100. For the Precision Ag program, the fall semester of 2019 marks the formal launch of the new program so it is anticipated that numbers will increase with each year, and even each semester. Students will continue their access and increase their engagement in Azure resources across the lifetime of their enrollment in undergraduate and graduate programs at NDSU.

The number of anticipated users across the Health Professions field is more difficult to determine at this time. However, leadership across several Health Professions departments have indicated intent to access these resources for management and analysis of restricted medical data sets.

How the expertise, equipment, and resources available to the project team, along with the funds requested, will address this need:

A dedicated partnership between NDSU and Microsoft will use these projects as an opportunity to test and deploy Azure cloud services in a model that is best suited for applied use both in the classroom and lab, and off campus at locations of field experiences and internships.

Recognizing the explosive growth in a global and competitive digital environment, NDSU continually works to position our campus network infrastructure as a state and regional front-runner. Ongoing investments in state-of-the-art network technology enable NDSU the ability to provide greater capabilities to address the needs of big-data, collaborations, research alliances/opportunities and data preservation. As a land-grant and research university, network engineers are continually challenged in providing innovative solutions and improved performance. The existing blend of advanced network technologies, tools and service management continues to evolve in an effort to meet the strategic goals of the institution.

Funding to support the cost of the first year of the Azure license and additional services will assist the IT Division in its efforts to provide tools and resources to constituents across campus for advancements in education and research. Assistance in funding the license in FY20 will provide additional time to refine plans for deployment and funding sustainability.

NDSU IT/CCAST will provide the necessary integration between NDSU infrastructure and Azure so that migration and interoperation is as easy as possible. This will include tasks such as:

- Integration of NDSU login (authentication and authorization framework) with Azure to provide single sign-on benefits.
- Streamlining of data exchange between central NDSU storage systems, Azure storage systems, and NDSU/CCAST storage systems.
- License management so that NDSU licenses have maximal portability to Azure.

People are at the heart of these efforts. Collaborations across campus leverage the expertise and knowledge of IT and CCAST Division staff, IT partners, various technology liaison groups and discipline specific professionals who contribute by sharing information and helping to promote an increased awareness of security and acceptable practices.

NDSU Student Technology Fee Action Plan Request

IV. Milestones

List the date for each project milestone. These milestones should represent the ***significant*** accomplishments that will be associated with the action plan. For each milestone, please indicate its expected outcome and the means for assessing that outcome. (The table may be extended as needed.)

	Date	Milestone	Expected Outcomes	Means of Assessment
1.	Summer 2019	• Training provided for Health Professions, Precision Ag, IT and CCAST faculty and staff on a variety of specialized Azure cloud service components to be used in each program's courses and field experiences, including Internet of Things (IoT), Artificial Intelligence (AI), and others. • First year of Azure license obtained and IT to set up and provision services to appropriate users.	• Increase knowledge base and skill set of Health Professions, Precision Ag, IT and CCAST faculty and staff relevant to cloud services that will play a central role in each program's activities. • Skill development will focus on sensors and other data collection applications in production agriculture enabled through the use of unmanned aerial systems and field-deployed weather and soil sensing equipment.	Training completed Azure back-end services set up and provisioned by IT and CCAST.
2.	Fall 2019, Spring 2020, Summer 2020 semesters	• Integration of cloud services into research data lifecycle by Health Professions. • Launch of new Precision Ag program, enabling students and researchers with cloud computing services that incorporate extensive use of MS Azure platform and services to support classroom, lab and field experience activities.	• Health Professions and Precision Ag students, faculty and research extension staff, and IT and CCAST staff partner to develop/test/deploy specialized cloud services for use in the Health Professions and Precision Ag program activities. • Secure funding for ongoing license.	Integration of cloud services and applications for academic and research experiences in Health Professions and new Precision Ag program including coursework, labs, field experiences and internships. User access rights are provisioned and monitored according to project needs.

NDSU Student Technology Fee Action Plan Request

V. Supporting Documentation

Please see the attached documents in the Appendix:

1. Letters of endorsement:

   Greg Lardy, Interim Director
   NDSU Extension
   College of Agriculture

   Dane Skow, Executive Director
   NDSU Center for Computationally Assisted Science and Technology (CCAST)

   Austin Eide
   Precision Ag Student
   NDSU

2. 21st Century Smart Farm White Paper

NDSU Student Technology Fee Action Plan Request
VI. Budget

(double-click on the form to begin entering data)

1.	NDSU ORGANIZATION OR UNIT
	Information Technology
2.	PROJECT DIRECTOR(S)
	(Must be NDSU faculty or staff)
	Kim Owen

3.	SALARIES AND WAGES			
	Personnel description	Number employed	Number of months	Funds Requested
	A. Staff			$0.00
	B. Graduate students			$0.00
	C. Undergraduate students			$0.00
4.	TOTAL SALARIES AND WAGES			$0.00
5.	FRINGE BENEFITS			$0.00
6.	TOTAL SALARY, WAGES AND BENEFITS			$0.00

7.	EQUIPMENT	$0.00
	Describe Equipment specifics in the Budget Justification section	
8.	MATERIALS AND SUPPLIES	$25,000.00
	Describe Materials and Supplies specifics in the Budget Justification section	
9.	TOTAL TECHNOLOGY FEE REQUEST	$25,000.00
10.	MATCH (Describe in Match Section)	$11,500.00
11.	TOTAL PROJECT EXPENDITURE	$36,500.00

NDSU Student Technology Fee Action Plan Request

VII. Budget Justification

Describe how you arrived at the budget totals in Section VI, Budget.

You are expected to follow all applicable university policies and procedures regarding salary expenditures.

Budget Line Items 3-6: Not applicable. No funds for salaries or fringe benefits are included in this proposal.

You are expected to follow the state-approved purchasing guidelines when purchasing materials and supplies.

- Equipment: List name, estimated cost and quantity of each item and explain why it is important to the project. Include installation and maintenance costs in your estimates.

Budget Line Item 7: Not applicable. No equipment expenses are included in this proposal.

- Materials and Supplies: List name, estimated cost and quantity for each non-equipment items and explain why it is important to the project.

Budget Line Item 8: This application requests funding for a one-year subscription to specialized cloud computing services for use by students, faculty, researchers, and staff at NDSU. Microsoft has indicated that an estimated value of these bundled services per user/per month would be approximately $500, resulting in an overall project cost that would be prohibitive. At that rate, the estimated overall project cost described in this proposal would cover Azure licenses for approximately six users. Project development and negotiations for these technology resources are ongoing at the time of this proposal submission. We anticipate many changes in the months to come and even more as the next year of activities is launched. Therefore, budgeted expenses are estimated based on the most current information at this time.

In addition to the baseline fees for Azure cloud services, additional software and Azure components needed for this project will be addressed in one of two ways: a) additional Azure components can be added to the baseline license as needed, and b) external industry partners whose applications require specialized software will provide access to the software licenses as needed for testing and deployment.

Non-equipment Item	*Value to the Project*
Microsoft Azure cloud baseline services	Azure has more than 100 services with end-to-end tools to support specialized project needs. Additional components function within the Azure cloud and can be developed and deployed from anywhere. Project specific intelligent apps can be created using Azure's data and artificial intelligence services.
Additional Azure components: 1. Azure IoT Hub 2. Device Twins 3. Cosmos DB 4. IoT core 5. VMs 6. SQL 7. IIS 8. Power BI	Resources and certification on security standards resources provided through Azure will be available at production quality that otherwise would not be available to the NDSU community. • IoT Hub: includes features such as device management and provisioning allowing the potential to scale multiple devices using familiar tooling. • Device Twins: used to store device-specific metadata in the cloud; report current information about a device application such as capability and condition; synchronize the state of long-running workflows between device app and back-end app; and query device metadata, configuration or state. • Cosmos DB: built with global distribution and horizontal scale at its core; enables global distribution by replicating data wherever users are located. • IoT Core: OS support and services to manage device updates and assess device health. • VMs: enables the creation of Linux and Windows virtual machines to be used for development and testing, running applications, and extending a datacenter. • SQL: fully managed relational cloud database service. • IIS: web app service • Power BI: provides business data processing results into analytics and reports.

NDSU Student Technology Fee Action Plan Request

VIII. Budget Match

1. Attempted Budget Matches:

External partners from business and industry will be invited to support the testing and deployment of Azure cloud services.

CCAST: To support the growing need for computational resources of restricted data, CCAST is willing to commit up to $5,000 in order to gain access to Azure resources to support the broader research community at NDSU.

Precision Ag Program: A growing list of businesses in the Precision Ag industry are requesting to partner with ABEN in the testing and deployment of hardware and software they currently have under development. Critical to the success of these newly developed tools will be their ability to interface with Azure cloud services so it is in their best interest to provide support for a portion of the services provided.

Health Professions: Preliminary discussions between the leadership in the College of Health Professions at NDSU, IT and CCAST indicate a strong interest in cloud computing resources that support the restricted data computing domain. They understand these resources come at a cost to the institution and intend to negotiate expenses with IT and CCAST to determine the level of support needed. No specific level of support is identified at the time of this proposal submission.

2. Actual Budget Matches:

IT: The Division of Information Technology will support this program by providing staff time for initial set up and provisioning of Azure services. In addition, a reasonable level of support services will be provided going forward.

CCAST: A commitment of up to $5,000 for FY20 in order to gain access to Azure resources to support the broader research community at NDSU.

Precision Ag Program: The College of Agriculture, through the USDA Precision Ag research fund and the Precision Agriculture major, could contribute matching funds in the amount of $100 per user to further support the first year of this license.

3. Additional Budget Match information:

Not applicable.

Appendix

1. Letters of endorsement:

   Greg Lardy, Interim Director
   NDSU Extension
   College of Agriculture

   Dane Skow, Executive Director
   NDSU Center for Computationally Assisted Science and Technology (CCAST)

   Austin Eide
   Precision Ag Student
   NDSU

2. 21st Century Smart Farm White Paper

NDSU NORTH DAKOTA STATE UNIVERSITY

February 15, 2019

To: Members of the NDSU Student Technology Fee Action Plan Request Committee

Re: TFAC Action Plan Proposal for Microsoft Azure

We are writing this letter to endorse the proposed funding request for Cloud computing services for NDSU Education & Research that is being submitted by NDSU's Information Technology Division. The opportunities to understand and use Microsoft's Azure cloud computing products will benefit NDSU students by increasing our institution's ability to equip current and future Ag producers and Ag industry workforce with the technology and data analysis skills required to speed adoption of precision agriculture.

There are two new activities at NDSU that could potentially benefit from access to Microsoft Azure cloud computing system, including the Precision Agriculture Major initiated in 2019, and a USDA-funded precision agriculture research project initiated in 2018.

The launch of the new Precision Agriculture Major program includes collaboration with two community colleges to address a pressing need in the region for a workforce skilled in the fast-changing environment of precision agricultural technologies. The future of precision agriculture will be built on digital data management, and our students will need to be knowledgeable and skilled in a variety of data management tools. Since Microsoft Azure computing tools are primary data analytical system used by major agricultural technology companies, it will be critical for NDSU graduates to be familiar with this technology. Potentially 45 precision agriculture students and faculty would use Azure in 2019-20.

The NDSU-USDA precision agriculture research project, "Advanced UAS/UAV application systems, data management systems, and bioinformatics tools that integrate GxExM data into precision agricultural crop management for regional relevant crops", is based in NDSU Agricultural and Biosystems Engineering Department. This precision agriculture research project will generate terabytes of data requiring management, transfer and analyses. Potentially 20 students and faculty would use Azure for this research project in 2019-20.

The College of Agriculture, through the USDA precision Ag research fund and the precision agriculture major, could contribute matching funds in the amount of $100 per user to further support the first year of this license.

COLLEGE OF AGRICULTURE, FOOD SYSTEMS, AND NATURAL RESOURCES
315 Morrill Hall | NDSU Dept 2200 | PO Box 6050 | Fargo ND 58108-6050
701.231.8790 | ndsu.coa-dean@ndsu.edu | www.ag.ndsu.edu/academics

Thank you for your consideration of this application request for funding for a one-year subscription to specialized cloud computing services provided by Microsoft to be used by students, faculty researchers, and staff at NDSU. Please feel free to contact me if you need additional information.

Sincerely,

Greg Lardy
Associate Vice President, Agricultural Affairs
Acting Director, ND Agricultural Experiment Station
Interim Director, NDSU Extension

David Buchanan
Associate Dean for Academic Programs

TFAC Letter

Center for Computationally Assisted Science and Technology (CCAST)

To: Members of the NDSU Student Technology Fee Action Plan Request Committee

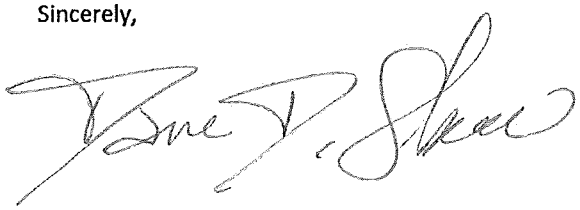
From: Dr. Dane Skow, Executive Director, CCAST

I am writing this letter to endorse the proposed funding request for Cloud computing services for NDSU Education & Research that is being submitted by NDSU's Information Technology Division. The opportunities to understand and use Microsoft's Azure cloud computing products will benefit NDSU students by increasing our institution's ability to equip current and future students to utilize industry-leading applications and infrastructure in their studies, their research, and their work once they leave NDSU. Not only will these skills be useful for students once they complete their studies, but learning large scale data analytic skills on commercial infrastructure. It will be critical for NDSU graduates to be familiar with this technology as data analytics becomes part of almost all business and research enterprises.

The Center for Computationally Assisted Science and Technology, through its software fund, will be contributing matching funds in the amount of $5,000 to further support the first year of this license.

Thank you for your consideration of this application request for funding for a one-year subscription to specialized cloud computing services provided by Microsoft to be used by students, faculty researchers, and staff at NDSU. Please feel free to contact me if you need additional information.

Sincerely,



Dr. Dane Skow

Executive Director, CCAST

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TFAC Letter

Center for Computationally Assisted Science and Technology (CCAST)

To: Members of the NDSU Student Technology Fee Action Plan Request Committee

From: Austin J. Eide, Natural Resource Management Graduate Student

I am writing this letter to endorse the funding request for enhanced Cloud computing capabilities that Microsoft Azure has to offer. I am a recent graduate of the Agricultural Systems Management department and I have always had an intense interest in Precision Agriculture. This interest has provided me with several different work experiences and also lead me towards seeking a career in the precision agriculture field. However, despite my positive work experiences, I still look back on my previous education and see opportunities for improvement. Precision agriculture demands individuals to be capable of adopting the latest technologies and more importantly, to be effective with them. This is something that I felt I did not gain much experience with during my undergraduate years and the addition of Azure is an exciting opportunity for NDSU to improve.

Furthermore, I am in the process of creating the first Precision Agriculture club at NDSU. The addition of Microsoft Azure to available student software gets me excited because I start to think of all the ways we could include that service in our club activities. Students will have new ways to interact with each other and will be provided with new methods to create and share content. The precision ag club is just now getting its start and to have access to this type of software at its beginning could prove to be a major benefit to the success of the club.

Student focus has always been a primary directive here at NDSU. In my opinion, an enhancement in the software capabilities will result in an enhancement of the student. Students who are properly exposed to the potential of this technology will find ways for it to benefit their studies and in turn, benefit their future.

Thank you for your consideration and I hope that you choose to accept funding for specialized cloud computing services provided by Microsoft.

Sincerely,

Austin Eide

NRM grad student

ABEN 223

Austin.j.eide@ndus.edu

21st Century Smart Farm – A White Paper from NDSU

Summary

A 21st Century Smart Farm is managed by a cyber-physical systems that integrates sensors, big data, robotics, and artificial intelligence to make accurate decisions on food production and ecosystem management based on accurate information. A smart farm will have an intelligent decision support system residing in a cloud or a server as the brain. It will receive inputs from a variety of sources, and communicates its decisions to the field machines to implement intelligent management decisions. We propose to develop one smart farm for crop production and one for livestock production, and demonstrate the benefit to crop and livestock farmers. The Smart farm will evaluate TV Whitespace for data transfer at a pilot scale, develop data management and decision support systems, demonstrate Microsoft AZURE as the brain, and develop programs to provide technology education to the large community including NDSU students, K-12 students and teacher, farmers, government agencies, and industries. A Microsoft Smart Ag lab will be developed at NDSU for training K-12 students and teachers, and NDSU students. Smart farms will be used as a testing ground for evaluating/developing precision agriculture technologies by researchers and collaboratively by industries. We propose a 5-year project that will integrate research, teaching, extension education and community outreach in partnership with the collaborating industries. Smart farm will also provide opportunities to startup companies to work with NDSU experts to further develop their technology. Smart farm is a giant step towards addressing the challenges of global food security, environmental stewardship, sustainability, and digital education in rural communities.

Introduction

As the world population grows to 10 billion by 2050, and the world faces the fastest growth ever of middle income people of 150 M per year [1], the crop demand is expected to increase by 100% [2]. Without precision management (or smart farming), it is expected that the growth in food production could result in deterioration or degradation of natural resources such as soil and water, and lost opportunity for increasing production efficiency. In addition, this is also happening at time when food production systems are being affected by changing climate. To address the global food security challenge, the world has to produce more food more sustainably and efficiently with fewer or same resources. A looming labor shortage in production agriculture also increases the need for smart farming, necessitating more remote management and autonomous/robotic operations in both crop and livestock production. Smart farms for 21st century propose to substantially increase agriculture production efficiency and sustainability by removing the inefficiencies in farm management decisions made by farm operators by allowing an intelligent computer systems to make those decisions. In the livestock sector, we expect the benefits to include improved sustainability and stewardship with better resource (pasture, soil, and water) management and use; improved animal care through earlier detection of possible disease states; and improved consumer confidence with enhanced knowledge of production system attributes.

Today, there are many new and advanced technologies in sensors, automation, robotics, and communication that are used in agriculture. However, most of these technologies are developed and integrated as independent systems. Agricultural production systems have many complex natural processes such as weather, soil biological processes, and rainfall-runoff at the center of the system. Therefore, the ability of an intelligent system to understand the interactions between the various parts (soil, water, weather, pests, etc) of production agriculture, and make best

management decision is extremely important. In other words, it is best to understand and evaluate farm management decisions from a system perspective. The Smart Farm project intends to use a systems approach to develop, integrate, and evaluate many different factors and technologies to improve production agriculture by developing a true cyberphysical system that continues to learn as production conditions change, and make intelligent decisions on how to best manage the system. A smart farm will optimize production operations on a large crop fields by managing it by the square inch, and in livestock production by managing the individual animal more precisely. The smart farm project proposes to address the many challenges that hold back today's food production from being a true cyber-physical system.

Project Objectives.

The long-term goal of the Smart Farm project is to establish a cyber-physical system for intelligent farming that will have (a) sensors to monitor the field, (b) an intelligent system (brain) that is constantly learning and making the best management decisions, (c) a communication system to transfer data between the brain, sensors, and field machinery, (d) field machinery integrated with autonomous system or robotic machinery to implement field decision, and (e) the brain analyzing economic and environmental benefits of the decision to continually learn and update its decisions. Over a period of time, the Smart Farm concept will be evaluated for multiple crops, crop genetics, and weather conditions to demonstrate its feasibility of such a system. Research, development, and education would constitute the core activities of the Smart Farm. Partnerships between academia, industries, and government would be another critical part of establishing and successfully operating the Smart Farms. The specific objectives of the proposed project are to:

1. Develop and evaluate a decision support system to optimize selected inputs (such as crop seeds, fertilizers and herbicide), utilizing MS Azure platform and data analytics tools.
2. Evaluate TV white space (TVWS) at a pilot scale for real-time seamless data transfer in a rural setting.
3. Evaluate smart farm technology to improve sustainability and efficiency of livestock production.
4. Evaluate selected robotic and autonomous machinery systems for implementing intelligent decisions.
5. Evaluate the economic and environmental sustainability of smart crop and livestock farming.
6. Establish a Microsoft Smart Ag Lab for education, and provide digital agriculture education to K-12 student and teachers, and other community members.

Justification

Currently crop producers on the Northern Plains make production decisions based on information randomly gathered at meetings and various commercial locations and online sites. At the same time, crop farmers routinely gather digital data on their soils, crop inputs, machinery operation, weather, crop yield, grain storage, and markets throughout the growing season. They lack technology to use all of this data to make real-time production decisions.

One issue preventing farmers from developing real-time smart technology on their field equipment is the barrier to data transfer in rural areas. Other deterrents for farmers to make optimum real-time use of data in crop production decisions include difficulties in accessing data

from multiple caches, and accessing mature computer software (decision making systems) capable of integrating the information into accurate decisions. The 21st Century Smart Farm will work with Microsoft to access wireless TV white space at the field level to transfer digital data between digital data hubs and farm equipment in the field.The 21st Century Smart Farm project will demonstrate data transfer, management technology and machine learning to integrate all data to allow computer controllers on each piece of farm machinery to make production changes in real-time while operating in the fields. The 21st Century Smart Farm will use expanded rural broadband technology to accomplish real-time crop and livestock management decisions.

As 21st Century Smart Farm technology develops, it will become apparent that some farm operations will be accomplished more efficiently with robotic technologies. As the rural population shrinks, average farmer ages, and farms grow larger in size, robotic technologies become an integral part of future farming. This project will integrate existing robotic technologies, and develop new robots to accomplish these operations.

A recent farmer survey conducted by our extension specialist, and data collected by Agriculture Education Program show that precision agriculture is the top ranked need area for education for farmers and school teachers. This project will use NDSU Extension education programs to collaborate with K-12 and university institutions to help teach practical computer science to students, train crop farmers to incorporate technology, and work with local industry to help create and fill 4.0 Technology Farm jobs.

Project Description

Smart agriculture is the incorporation of cyber-physical systems into agriculture by integrating sensors, robotics, and big data into agriculture (Fig. 1). The system will be a completely connected (wirelessly) system that requires historical and real-time data (on soil, crop, and weather), makes real-time decisions based on historical patterns and current field conditions, communicate the decisions to autonomous/robotic systems to implement in the field, collect data on the field machinery operation, and evaluate the economic and environmental sustainability of the decisions based on crop or animal performance data.

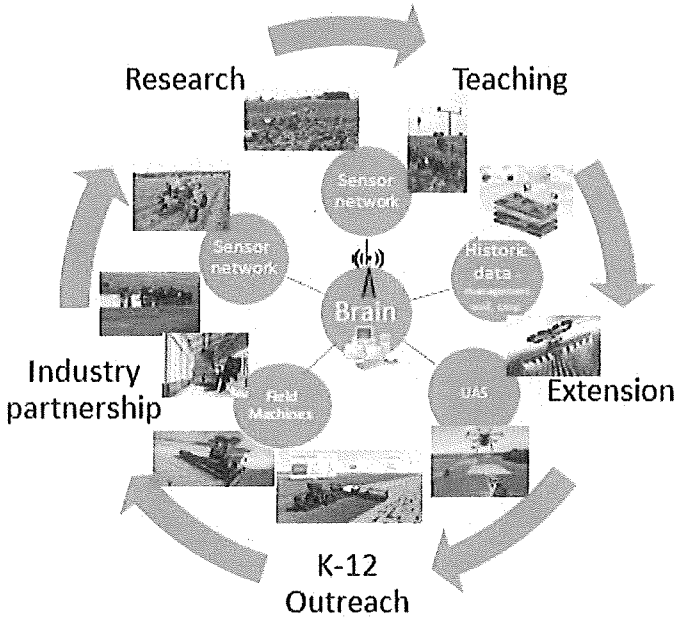

Figure 1. Concept of Smart Agriculture

The Smart Farm for crop production will be established at the NDSU Agronomy Seed Farm at Casselton (Fig. 2). In the first year, a 100-160 acre field will be established as a smart farm. In the second year, a smart farm will be

established in Fargo for livestock. Both farms will work under the principle of managing the individual (plant or animal) based on historical and real-time information to increase production efficiency and for better sustainability. Each farm will also have several research and educational objectives as listed below:

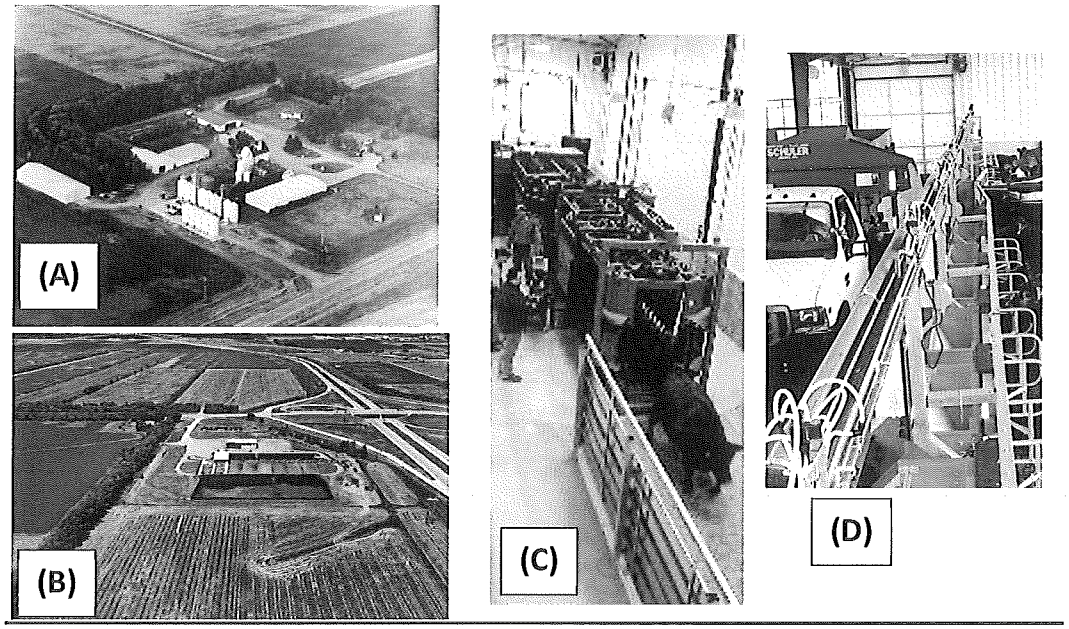

Figure 2. Research sites – (A) Casselton Agronomy Seed Farm, (B) Beef Cattle Complex, and (C-D) Automated milking and feeding stations at the Beef Cattle Complex.

Objective 1. Develop & Evaluate a Smart Farm Decision Support System. Under this objective, we will develop and evaluate intelligent decision support system for optimizing planting rate, fertilizer application and herbicide application. For example, the fields in Casselton have a salinity problem in some areas. The planting rate will be adjusted in these areas while planting full recommended rate in non-affected areas. The field will be split into 6-8 large strips for comparison purposes. Alternate strips will be planted using variable rate using the intelligent decision while the remaining areas will be planted at a conventional rate. Monitoring crop yield and the environment would allow us to statistically evaluate the two decisions.

Similarly, the concept of an intelligent decision support system for intelligent weed management is shown in Fig. 3. The fields will be monitored with high-resolution unmanned aerial system (UAS) to map weed plants, their species, and herbicide resistant so that a site-specific weed management system can be developed and implemented. This system will apply herbicide only where there are weeds, and customize the herbicide to suit the species and weed condition. Thus, the system will reduce herbicide applied to the field, providing economic and environmental benefits.

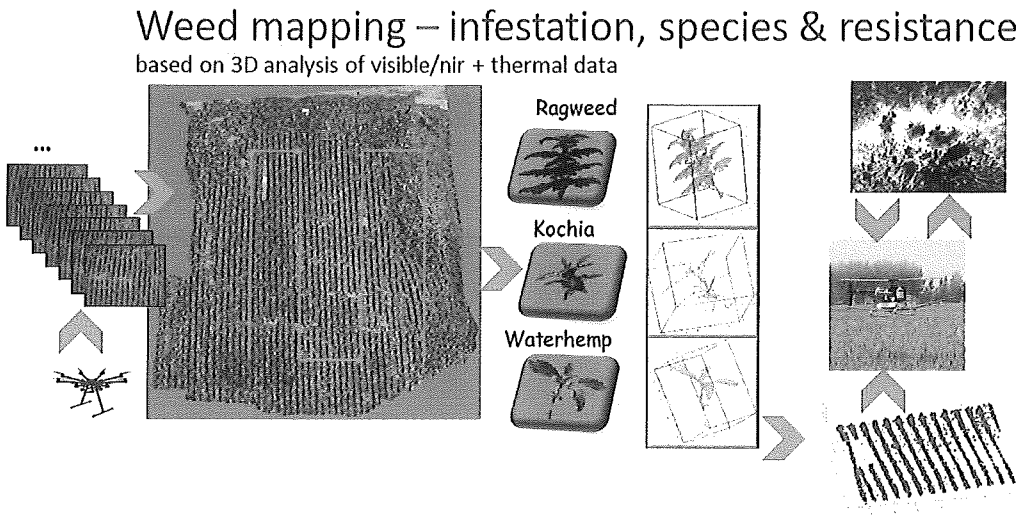

Figure 3. Site-specific Herbicide Management

This objective will include extensive processing and analysis of different types of data including weather, soil sensors, crop sensors and UAS. The data from UAS will be large size, and require extensive processing to mosaic and correct/calibrate. The data will be stored in NDSU Center for Computationally Assisted Science and Technology (CCAST) computers, and processed using the Azure platform. These data will be processed using in house algorithms developed by our group as well as the data analytic tools in the Azure platform.

Obj. 2: Evaluate TV White Space (TVWS) for data transfer. In collaboration with Microsoft, our project partner, we will establish a base station and tower with antennas with a 360 degree coverage at Casselton. Each of the field deployed sensors will be modified to have its own client station to transfer data using the TVWS. We will evaluate TVWS for the speed of data transfer, and real-time and near real-time data transfer. We will also compare TVWS to wireless data transfer speeds at peak and non-peak times.

Obj. 3. Evaluate smart farm technology to improve sustainability and efficiency of livestock production. Components of this objective would include using active RFID/GPS tags to remotely monitoring livestock locations and movements on pasture, remotely monitor inventory of grazing animals and range conditions using imagery collected with unmanned aerial systems (UAS), and remotely monitoring water level in watering locations. Longer term, these processes may be used to remotely control access to certain pastures or parts of pastures using smart farm technology.

Demand for meat, milk, and eggs worldwide is growing rapidly as populations grow and as more people move into a middle class income bracket. This has led to a growing demand for these products, placing a strain on production systems. The need for Smart Farm technology as a means to improve both the sustainability and efficiency of livestock production is more and more apparent. Producers desire to produce high quality, healthy, and safe food products. However, especially for livestock on pasture, the ability to remotely monitor and manage these livestock is limited. There are numerous animal and environmental factors which affect end product quality (genetics, reproduction, nutrition, behavior, pasture quality, environmental stressors). Our

project will evaluate how to monitor and manage these factors on the farm as well as investigate the impact they have on product quality at the consumer level. We also know that antemortem and postmortem factors influence this as well and we will develop and evaluate prototype precision livestock management systems that can provide data in real time to improve sustainability of livestock farming systems. Our research projects would utilize sensors such as color and spectral cameras, UAS, and GPS to acquire the data in real time, input these data into decision support software in order to allow remote access and decision making for Smart Farm operators. This intelligence data processing workstation will process data in real-time through cloud data technology and with output management solutions that allow our Smart Farm scientists to react by combining this data with more subjective observations and experience.

Our scientists are already involved in several projects related to the use of such decision-making tools in livestock production. These projects include predicting early stages of respiratory disease in beef cattle using near-infrared spectroscopy (NIRS) technology, assessing consumer purchasing behaviors based on beef quality attributes using mobile applications, and investigating the relationship between beef cattle temperament and beef quality using near-infrared, video, and thermal imaging technologies. Data from these projects could easily be integrated into the Smart Farm project.

Obj. 4. Evaluate robotics/autonomous system, environmental & economic benefits. The decisions developed by the decision support system will be wirelessly transmitted to farm equipment such as planters and sprayers for field implementation. Our partnership with Case New Holland and Titan Machinery will be used to evaluate autonomous/robotic systems for implementing decisions or variable rate application of selected inputs. The benefits of these decisions to the environment and the economics of the farms will be evaluated.

For evaluating environmental benefits, the gas emissions from the field will be monitored and compared to adjacent fields. Both surface runoff water and ground water samples will be collected to evaluate the chemical loss to the environment. Economics of smart farming will be evaluated using the crop yield from conventionally managed plots against smart field plots, against crop inputs.

Obj. 5. Evaluate the economic and environmental sustainability of smart farming. Project will monitor all inputs used, input costs, crop yield/livestock, and prices to perform an economic analysis. We will also monitor soil, water, and air quality throughout the five years, starting from prior to establishing smart farm, to understand environmental gains. These data will be used for understanding the economic and environmental sustainability of smart farming

Obj. 6. Develop a Microsoft Smart Ag Lab & provide digital agriculture education. NDSU is the process of developing a new major in precision agriculture. There is also considerable interest among students in agriculture, engineering, science, and business to learn more about precision agriculture. We will develop two new Microsoft labs: one focused on mapping, big data, analytics, and artificial intelligence; and a second lab focused on robotic/autonomous system lab focused on sensors, controllers, and robotics. These labs will serve as the core facility for training NDSU students, K-12 students and teachers, extension agents, and other interested groups in smart farming technologies. The project team will work with local 4-H teams to develop a robotic spot sprayer for herbicide or insecticide application. Students and teachers from surrounding K-12 schools will be invited for field visits and demonstration. Researchers from the team will give talks at the schools and at STEM camps.

We will organize field days at the smart farm to demonstration the working of the farm, and its benefits to community members and legislators. NDSU classes will also use the smart farm for field tours, data collection, evaluation of various components of the smart farm, and for conducting class labs and projects. The project will train undergraduate and graduate students as integral part of the team, developing, establishing and evaluating the farm.

The Plan and Costs (Total: $6.65 M)

We will pursue federal/state government opportunities for cost sharing.

Year 1 Tasks (~$1.25 M)

- Establish and evaluate TV white space for data transfer from Casselton
- Set up and training in Azure platform for data management & analytics
    - Training of investigators on Azure platform and analytic tools
    - Setup Azure for data storage & evaluate analytical tools
    - Evaluate seamless bidirectional data transfer between field sensors/UAS and the Azure platform
- Establish smart crop farm at Casselton
    - Acquire sensors and robotic systems, install them for use of TVWS.
    - Collect historical data, install field sensors, and establish seamless connection between sensors, data platform, and robotic/autonomous machines for field operation.
    - Develop/evaluate real-time data transfer and management protocol
    - Develop decision support using in-house and Azure analytics
    - Develop and evaluate selected field management practices (ex, variable rate planting and herbicide application)
    - Evaluate economic benefits of smart farm
    - Evaluate environmental benefits (air quality, water quality and soil quality)
- Smart Farm and digital agriculture education
    - Establish a Microsoft Smart Agriculture lab at NDSU
    - Field days for all community members
    - Tours of smart farm for K-12 students
    - NDSU class tours and field experiments
    - Robot development for spot spraying by 4-H and NDSU student club
    - Develop course materials for STEM summer training program

Year 2 Tasks ($1.7 M)

- Establish and evaluate TV white space at Fargo Smart Farm.
- Continue data collection and research at Casselton Smart Farm.
- Establish smart livestock farm at Fargo (install sensors, establish communication/data transfer system, data analytics, etc).
    - Establish research projects at the Fargo smart livestock farm.
- Develop a protocol for establishing smart farms.
- Establish a robotics/autonomous system lab at NDSU
- Expand digital agriculture educational activities.
    - Continue all the established site tours, field days, and demonstration activities for farmers, livestock producers, K-12, and general public
    - 4-H and robotic club – develop a fspot spraying robot.
    - Offer STEM hand-on training in robotics & autonomous system to K-12 and NDSU students.

- Engage startup companies in the smart farm initiatives by collaboratively evaluating their technologies.
- Present research findings at conferences, field days, and other events.

Year 3 Tasks ($1.42 M)

- Continue evaluating TV white space at Fargo, and Casselton
- Help one of the Research and Education Center (REC) to establish a smart farm.
- Continue data collection and research at the smart farms in Casselton and Fargo.
- Develop and submit a proposal to USDA or NSF for a Center for Smart Farming.
- Continue community education activities as in previous year by hosting field days, STEM camps, and student club activities.
- Incorporate the experience into Fargo-Moorhead Chamber leadership training events, and startup/innovation focused events.
- Present research findings at conferences, field days, and other events, and through journal and extension publications.

Year 4 Tasks ($1.19 M)

- Continue to evaluate TV white space
- Establish satellite Smart Farm location for extensive pasture operations in the Ekre Ranch located in the Sheyenne National Grasslands
- Continue data collection and research at the Smart Farm
- Establish one more smart farm at Langdon REC
- Continue community education activities as in previous year by hosting field days, STEM camps, and student club activities.
- Present research findings at conferences, field days, and other events, and through journal and extension publications.

Year 5 Tasks ($1.08 M)

- Continue to evaluate TV white space.
- Continue data collection and research at all Smart Farms.
- Continue community education activities as in previous year by hosting field days, STEM camps, and student club activities.
- Present research findings at conferences, field days, and other events, and through journal and extension publications.
- Prepare the final report.

Outcomes and Impacts

- The project will prove and demonstrate the concept of smart farms (one for crop and one for livestock) as a modular and replicable idea.
- Four smart farms will be established at NDSU for research, education, and outreach in rural and urban areas.
- The project will demonstrate a significantly more efficient food production system that produce more food from the same land area with limited resources to feed the growing world.
- A livestock monitoring system that allows farmers to follow and manage the individual animal's status and well-being closely at all times. We will investigate and develop a system based on thermal and visual sensors that can detect early stages of respiratory disease in beef cattle.

- A pasture and livestock monitoring system which would enable livestock producers to remotely monitor and manage herds or flocks and more sustainably manage forage, soil, and water resources necessary for livestock production.
- The project will quantify the environmental benefits of smart farming, and demonstrate a smart food production system that will reduce chemical usage and chemicals escaping to the environment, thus, contributing to soil health, cleaner water, and higher quality produce.
- The proposed smart farming system is expected to reduce the carbon, nitrogen and water foot print of agriculture, with the help of technology.
- A Microsoft smart agriculture lab and robotics lab will serve as the core facility for educating NDSU students in the latest technologies. The labs will also serve as the critical facility for training K-12 students and teachers through summer training, and other educational opportunities that will be developed as part of this program.
- The Microsoft lab facility will be an integral part of the new major and minor in precision agriculture that NDSU will be developing.
- New NDSU courses will be developed as part of this project to train NDSU students.
- The project will provide digital education in agricultural communities in both rural and urban areas.
- The project will evaluate the TV White Space technology for large data transfer in rural communities.
- Project will contribute to K-12 education through active participation of 4-H clubs, FFA, and local schools, in collaboration with NDSU student club thus, helping to recruit more students to STEM fields.
- We expect to increase students' interest in STEM discipline, create awareness on producing the food we eat, and attract more and diverse students to STEM higher education.
- Workforce development in the region through traditional and hands-on training of both graduate and undergraduate students at the smart farm, and Microsoft labs.

Tentative Partners

NDSU Department of Agriculture & Biosystems Engineering (lead)
NDSU Agronomy Seed Farm
NDSU Department of Animal Science
NDSU Center for Computationally Assisted Science and Technology
NDSU Department of Agribusiness and Applied Economics
NDSU Department of Plant Sciences
NDSU School of Natural Resource Sciences
NDSU Information Technology Services
NDSU Department Computer Science
NDSU College of Engineering
Midwest Big Data Hub
Industry: Microsoft, Titan Machinery, Elbit Systems of America, CNH, Aker, Skyskopes

Reference

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