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Project title : Teagasc app

Document : Project Report

Date : 2020/2021

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1.0 Introduction

This document contains the development process of the TAA (Teagasc Advisors App), renamed by the client Robert Sheriff to the Teagasc Nitrates Management Planner. TNMP is a full stack project focusing on the levels of nitrates and potassium held by farmers wishing to apply for government schemes. The software (application) is developed using Django, Python and a MySQL Database with some javascript for more interactive web pages. The application will be used in the Teagasc offices in Gorey, Enniscorthy by Advisors, who will assess farmers using the system and finally submit a detailed report.

This report will outline the description of the final project, the technology used in creating this project, and a brief overview of each of the main functionalities of the application, difficulties faced during the development, how the project changed drastically, how these obstacles were overcome and some of the issues that remain, finally a section containing future prospects for the app.

This report will contain a section explaining how the final product differed from the original idea specification, this section will explain what changed during development, why certain features were invalid, and the resulting changes.

A small section explaining the concept of the app and how it came to become my project, the learning outcomes, and personal outcomes during the development.

Finally an acknowledgement section to thank those who helped and supported the development of the project, a conclusion and a review of the completed project. This section will also explain that if this were a new project how I would approach it now and how development would be a lot smoother.

2.0 Project Description

The project results in a full stack web application with the front end designed to be used by the advisors to assess a farmer, the data recorded from the farmer is then saved in a MySQL database. The application will allow an advisor to first assess a farmer for their stocking rates. This is a unique implementation as development has led to the conclusion this method will in fact speed up production. The main
features will be explained below in order. These features have been researched, explored and fully explained in the research document.
When an Advisor logs in to the application they will be greeted with the home screen and the menu of functionality contained in the app. The first feature an Advisor will use is the Conduct Assessment feature, which after receiving the data will carry out a whole farm stocking rate, grassland stocking rate, record 5 land and livestock unit per hectare. With these figures it is now possible for an Advisor to further assess a farmer.

A farmer may wish to import or export depending on the whole farm stocking rate, which as mentioned above will be returned from the Conduct Assessment feature. Importing or exporting affects a farmers whole farm stocking rate, nitrates and potassium levels.

Slurry Storage is a feature for recording shed sizes on farms for storing Slurry or Farmyard Manure. The sizes of these sheds, location indoor or outdoor, the county in regards to rainfall and required weeks of storage which will indicate if a farmer needs to increase the amount of storage on the farm.

A fertiliser plan, at the time of writing is not fully implemented but this feature will record the types and amounts of feed, soil samples, whole farm stocking rate and return a total amount of chemical nitrogen and phosphorus which the farmer can purchase, which will then be further broken down into fertiliser type. The fertiliser plan will also perform a lime plan which from the soil samples will provide a total amount of lime which can be spread over a 4 year period.

Finally the app will print an informative simple report at the end of each function and there will also be separate functionality for displaying completed assessments and farmers current totals.

3.0 Issues Encountered

Personal

Due to having no set specification to work from I was using a Microsoft Excel sheet that I was provided with by Robert. This had a small number of tabs with huge amounts of information on each page. I had begun to mirror the excel sheet which had started leading me in the direction of NMP. Prior to this meeting i was unsure of what was expected of me and I was putting everything in which was making my application too cluttered with no clear direction in sight.
When I was developing this application, understanding the role of an advisor became tricky at times.I soon discovered there was no set equation for calculating certain figures as there are so many variables to be taken into consideration.

Technical

Understanding the concepts of how templates function, for example when to use double braces, when to use single braces, how to use a for loop or how to access elements within a collection and use these elements effectively. Rendering HTML elements was a difficult issue to overcome at first, understanding widgets and becoming familiar on which one worked best or learning how Django's MVC separates logic from the visual side of the application took time to fully comprehend. Django's MVC I found to be useful, at first this concept confused me. Understanding when to use a list of tuples compared to a dictionary reduced the code base by 30 lines. Not having in depth knowledge of these structures led to more work and code. Knowing when to use which structure and what functions were offered by these structures meant Understanding Pythons data structures, I was not fullyAttempting to try to make web pages more interactive was a challenging process as the target audience for this application have low computing skills, this meant configuring a user interface to be friendly yet informative, or trying to minimise the input required. This needed to be achieved in a very short period of time. Deployment of the application was a smooth process yet as users began to use it bugs appeared. The error report returned from Python Anywhere was

difficult to understand but not knowing how to debug slowed down. This took time to understand the issue and retrace my steps in order to solve the problem. The database used in the development contained vital information for the application to run, data associating to calculations. Deploying the application did not include this table meaning the application could not function correctly. Realising how Python anywhere hosts the databases meant uncovering the fact that two databases existed, figuring out how to use which database or update the default to contain the required data caused a point of confusion. Using the phpmyAdmin UI was a luxury when after deploying the application any work with the database had to be achieved through a mySQL shell, at the time my
SQL syntax was below the standard needed to accurately fix database issues such as missing data or removing invalid table entries.
Debugging errors on Python anywhere meant knowing how to navigate separate pages, following code and knowing when to reload it caused much lower productivity, this was due to not understanding how simply errors can be introduced to the code, if this had of happened on the development application then these errors would have been swiftly evaluated.
Debugging in the development application was a slow learning process at first, sometimes debugging was being done in the wrong place, problem solving skills and deduction experience led to deductive reasoning understanding where and why an error was caused and where it could be resolved began as a process that would change between debugging the web page when the error had occurred in the views logic not the page structure.

I appreciated Python anywhere as this provided a much more seamless experience as researching AWS led to many confusing tutorials. I am grateful for the exposure that Paul Barry provided on Python Anywhere as past lessons came back to help me.
Making a form appear on a table is not a straightforward process, this took time to find the best suited method. Deploying the application revealed bugs not seen before the css of the page was done incorrectly, this meant that as the page was viewed on different browsers elements on the page were not presentable causing hours spent using relative values.
Migration errors caused issues where everything had become out of sync, this meant having to drop the database on 2 separate occasions. Not knowing when to use session variables meant trying to instantiate variables again or reusing code.

4.0 Learning Outcomes

This project was the largest most difficult task I have ever undertaken, as I did not fully understand what was expected and there was no clear direction as with how this application operates there are so many variables to be considered so breaking this application down into separate functionality was no small task. Understanding
how to deal with the Client and produce software suitable for a state run body.
Working closely with Django and Python, the experience and time taken were invaluable. Working with Django there was always a way to solve a problem, usually implementing a new feature or using one of djanos resources. Pythons versatility and time working with Python increased my coding ability tenfold. Errors and bugs were solved in less and less time. Building a full stack application, understanding how each component fits, and then delivering an application is an experience that can't be explained. Seeing the application used by the advisors in two different offices was an amazing feeling, knowing my software worked and helped make their duties easier. Deploying the application and

populating databases and ensuring the application behaves as expected was a task that saw me fully explore edge cases and try to prevent them.

This project was treated with utmost sincerity as it was to be deployed pending success, this meant having to communicate with other advisors I had never met, arranging meetings with Robert and demoing current prototypes, taking feedback and using that to improve the application.

The most valuable lesson learned this year was learning how to interact with the client, organise meetings on the development of the application and showcasing project progress and maintaining consistent communication while still focusing on the deliverance on adherence to the specification and changes that arrive whilst still adhering to college requirements. I learned that debugging in Python in a moderately sized code base provides a challenge greater than debugging single task based scripts due to the increased complexity of the inner workings of a system. A single change can propagate to multiple areas of a system often causing undesired effects, I think a developer needs to remain conscious of how a change may affect the system as a whole and I am glad to have gained this experience. I learned the value of following my thought process before attempting to write code. Writing code without due thought led to many unnecessary bugs being introduced to the code. Learning how to use git comfortably understanding branches and how and when to merge was a difficult concept. Learning to write maintainable readable code rather than functional code, writing something which I could come back and understand rather than a complex function that meant having to understand the thought process behind it. Python's minimalist syntax greatly helped in writing maintainable code with its enforcement of whitespace and its lack of functional characters such as semicolons aided in the readability and long term maintainability of the code. However Python itself does not mitigate the problem, A developer must remain conscious of writing readable and maintainable code throughout development.

Learning how to develop an application from the beginning was a unique experience, choosing the technologies for the project and the multitude of tools can be a challenging feat. It is important that a developer chooses technologies that are appropriate to their project. For example in my project, due to different changes in the specification, had I chosen a lower level language this would have caused a great difficulty in the completion and deliverance of the project. Python felt like a great fit here as Python emphasises developer productivity allowing the developer to focus on the intended behaviour of the application without the need to focus on minute technical challenges. I am grateful to the Python core developers and its community for the tools they have made available throughout the project.

5.0 Description of Conformance to Specification and Design

The original specification was based on a Microsoft Excel application which offered several features, accurately but due to advancements in technology became obsolete. The idea was to utilise the Excel application’s features and implement them in a more friendly manner, displayed in a more user friendly environment with the main goal to produce simple easy to read reports. NMP is the current system in use by Teagasc Advisors, so I decided this will be used to compare my calculations. After 3 months, I had only managed to calculate a stocking rate and a whole farm stocking rate, which with time being a huge factor decided to arrange another meeting with Robert who informed me that the project was starting to look very similar to NMP, which I will admit that from working so closely to NMP parts of the application began to emphasize this. With that said then Robert provided a list of important

features that if correctly implemented and reached the goal of providing a simple report would result in a highly sought after application which could greatly influence the future of how Farmer assessments were carried out.

The Original list of features were :

Fertilizer Plan

Stocking Rate and Whole Farm stocking rate

Lime Requirement

Slurry Storage

Also the app aimed to update totals and display amounts of fertiliser which could be spread. I took on this challenge not understanding the weight of the responsibilities of an Advisor. From this point I mostly researched the responsibilities of an Advisor
and how they deal with Farmer applications. What I found was that Advisors have their own calculations which they carry out on paper mostly in order to quickly complete NMP applications. The functionality required does not exist. An example of this is Record 5 land which dictates how rented land may be assessed, or Livestock unit per hectare which is what the name implies, calculates how many animals are on each hectare of land. Yet this feature also doesn't exist. NMP and the Microsoft Excel system were built by a team of developers working closely to a well documented specification, luxuries i did not possess.

The project needed to be redesigned but the timeframe was against me and there was only one feature implemented and the reports were not satisfactory. From my research I was trying to figure out the calculations and what figure affected which. Eventually my research led me to the fact that without a stocking rate an Advisor should not be able to assess a farmer further, which led me to use this as the central part of my application. From the Conduct Assessment feature a farmers herd no, which is a unique ID, their number of hectares and the number of Livestock they possess. From here I could calculate the Livestock unit per hectare, Record 5 land, both stocking rates and the number of Nitrates and Phosphates, all very important pieces of data.

6.0 Description of Learning

This section will explain the learning outcomes from the development of this project both technical and personal. Not having the luxury of being able to attend college and lectures, or having the same quality of 1:1 with supervisors and lectures has made this year much harder. Not understanding the weight of the project was also a factor. With a very busy working life this year really tested me. Due to the project I had undertaken I needed to understand most of the workings of a Derogation Advisor at Teagasc, who assess farmers who aim to receive grants from the government. In third year I was first introduced to both Django and Python where the main task was to create a simple Django app. With how difficult I believed my project to be I decided to use Django as I thought my experience would be an advantage and with the rising popularity of Python this would be a rewarding experience for my career. Last year I was introduced to django and with its all batteries included design I felt that this would speed up development, understanding how templates are fitted, manipulating information correctly on each element of a page became difficult as with more functionality there was more code and files, refactoring the code base became a longer process as this took time to break down how each template is accessed and understanding which

functionality went where. This process familiarised myself more with each of the components in django making it easier to update and add functionality at a later date.

Getting the opportunity to work for a client and deliver an application with a short deadline whilst trying to deliver something that would be accepted and used by the target users. Hours of breaking down how nutrients on a farm are broken down, produced. Understanding the science behind Derogation assessments. Not possessing documentation led to understanding the value of having a well written specification. Creating something from nothing with no background in this specified field, with the promise of the application being used by the target audience upon completion. The satisfaction of receiving such positive feedback from long term advisors who had worked with the technology I researched loved my application. Robert was truly amazed with the result to the point that he followed each feature with pen and paper and calculator to verify. Such minimal input led to swift accurate results that farmers could clearly understand. Farmers of an older generation were shown results of calculations printed from the app and could easily follow with almost no questions. This was something that had been required for a long period of time. Maintaining a deployed application removing bugs discovered by users in a minimal time frame whilst still maintaining college documentation was a challenge. This year was harder with having to deliver something that would be used in everyday advisory work whilst also aiming to achieve the best results was a valuable lesson.

Robert has requested extra functionality which will be implemented in order to demo to the Department of Agriculture. This application has a strong future with many further prospects, constant new schemes with different requirements will further the need for additional functionality whilst also aiming to deliver a truly unique application with a continued success rate. Emails have been attached to this document to portray advisors opinions and Roberts review.

7.0 Review of Project

After many months of this web application and change in direction this application is being used in Teagasc Offices in Wexford (Gorey and Enniscorthy). Mid way through the development stage I had a meeting with Robert who requested extra functionality: Record 5 land and livestock unit per hectare. These were unique features which were present in no other application. The original functionality required was:

· Grassland and whole farm stocking rate

· Slurry/ farm yard manure storage

· Imports/ exports

· Fertiliser plan

With the added requests I had to implement 6 accurate features to the webapp. To date I have 5 accurate working features on the application. Along with having 5 working features there is a simple/ clear reports page which has minimal information and is easy to read- another request made by Teagasc. Advisors will be working with private data so I have added a login system so each advisor will give their own unique username and password. This is set up by the administrator only.

In my final meeting with Robert, I renamed my application to Teagasc Nitrates Management Planner.

When I deployed the application I received much positive feedback- advisors also believing that this application has potential to be used as a nationwide Teagasc app once the final feature (Fertiliser plan) has been implemented.

The accuracy of the app in its current state has been tested by advisors and they have been happy with the results which are returned as this was now being tested by real farmer data.

8.0 Acknowledgements

Firstly I would like to thank Robert Sheriff, for the opportunity to work and develop an application that would be used every day by Teagasc Advisors, the application wouldn't exist without him.

I'd like to thank Dr. Chris Meudec for his support, assistance and dedicated involvement throughout.

I cannot express enough thanks to Lilly, a great friend who listened to more than their fair share of my ramblings.

9.0 Appendix

Teagasc
Agriculture and Food Development Authority

Seirbhísí Comhairleacha agus Oiliúna
PÁIRC NA DTAISPEÁNAS
Gaoire, Co. Loch Garman
Advisory and Training Services
SHOWGROUNDS
Gorey, Co. Wexford
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26th April 2021

To whom it may Concern

Review of Damian Doran's final year Programming Project

Entitled Carlow IT/Teagasc Organic Nitrates for Advisers and Farmers

I wish to confirm that I have worked closely with Damian Doran on his final year Carlow IT program - A farm Organic Nitrates program for farmers and advisors

This program is designed to allow advisors and farmers exam in a simple way the details of the farms organic nutrients situation. This is a complicated background calculation but it was important that the input and output sheets for the programme had to be presented in a simple format to make the information easy for farmers and advisors to use and read.

I know Damian has worked extremely hard on what has been a huge challenge and I was impressed with the detail, dedication and just as importantly the clarity of the outputs of his program.

He has shown excellent attention to detail to the work program which is an unfamiliar topic to him and I am extremely happy with the results of his work and his overall commitment and input into a challenging topic.

I believe the result of his work is a useful programme and the overall programme outputs will be impressive to interview panels when he goes for a job applications in future

He has been a very keen student to work with and I wish him the best in his future job plans

Yours sincerely

Bob Sherriff
Teagasc Adviser

Apologies had meant to come back to you sooner on this. The idea is good in principal so there are a large number of farmers not in derogation/exporting etc that wouldn't have a NMP. A few observations I would make:

1. I presume there will be some way to link up soil results to plots. Maybe include a field name box as a way of linking samples as farmers much prefer this method rather than LPIS numbers. Could use LPIS numbers also
2. Livestock page looks a little cluttered and could put people off. Could you just leave the 5 cattle groups along with lowland ewes and lambs with the option to click on an 'add' button for extras? First 4/5 options would cover the majority
3. Similarly with the feed page. Maybe just leave in compound ration option and barley with the option of an 'add' button again
4. Most importantly on the last page total kgs of N & P won't mean much to farmers. It would be great if you had a drop down menu of fertilisers at this point that they could click on say 5 tonnes of 18-6-12 and this would automatically deduct from their total. Think this happens on the Teagasc fert app? If you could convert kgs to units also or give both options it would prob make more sense to them

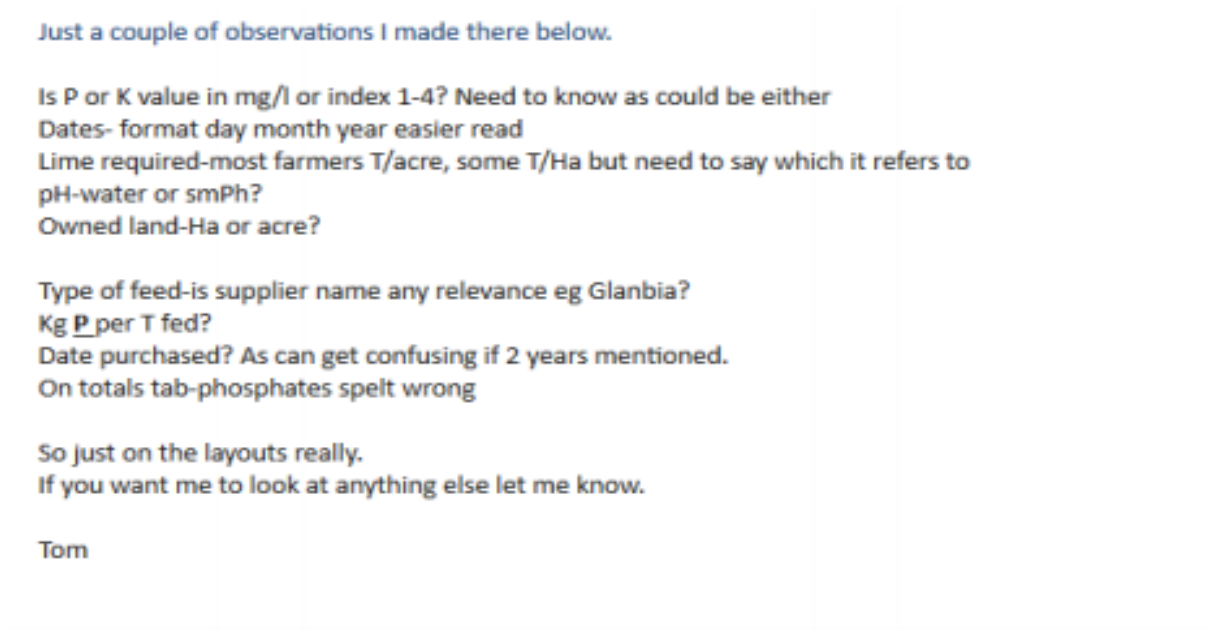
The simpler you can make it the better I would suggest. Hope that's some help.

James.

James Doran,
James Doran, Drystock Advisor
Teagasc, Old Dublin Road, Enniscorthy, Co. Wexford.

Email from James Doran;Beef Advisor

James Doran- Profile at Teagasc- www.teagasc.ie/contact/staff-directory/d/james-doran/



Just a couple of observations I made there below.

Is P or K value in mg/l or index 1-4? Need to know as could be either
Dates- format day month year easier read
Lime required-most farmers T/acre, some T/Ha but need to say which it refers to
pH-water or smPh?
Owned land-Ha or acre?

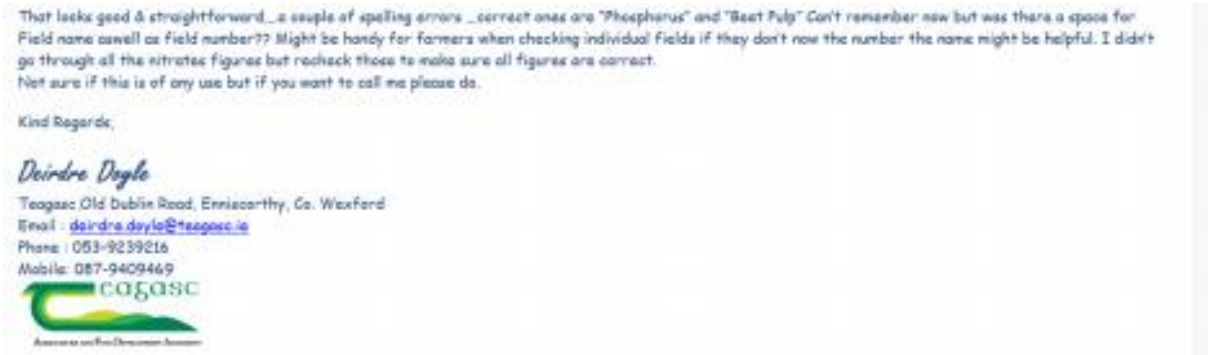
Type of feed-is supplier name any relevance eg Glanbia?
Kg P per T fed?
Date purchased? As can get confusing if 2 years mentioned.
On totals tab-phosphates spelt wrong

So just on the layouts really.
If you want me to look at anything else let me know.

Tom

Email from Tom Deane; Drystock Advisor

Tom Deane- Profile at Teagasc www.teagasc.ie/contact/staff-directory/d/tom-deane/



That looks good & straightforward...a couple of spelling errors ...correct ones are "Phosphorus" and "Beet Pulp" Can't remember now but was there a space for Field name aswell as field number?? Might be handy for farmers when checking individual fields if they don't now the number the name might be helpful. I didn't go through all the nitrates figures but recheck those to make sure all figures are correct.
Not sure if this is of any use but if you want to call me please do.

Kind Regards,

Deirdre Doyle
Teagasc Old Dublin Road, Enniscorthy, Co. Wexford
Email : deirdre.doyle@teagasc.ie
Phone : 053-9239216
Mobile: 087-9409469
teagasc

Email from Deidre Doyle; Beef advisor

Deirdre Doyle- Profile at Teagasc www.teagasc.ie/contact/staff-directory/d/deirdre-doyle/

In relation to the NMP advisors application I make the following remarks.

1. The concept is well thought of and provides a simple to use tool for quick calculations.
2. It would be worth adding units to the application if possible to distinguish what the figures are representing. At the moment there is just figures which is a bit confusing to the user.
3. Overall I think it has potential so long as it does not get mixed up with the NMP that is already in place.
4. A bit up tidying up around units etc. will go a long way towards making it a successful application.

Regards,

Mark Boland

Agricultural Catchments Programme Advisor Teagasc, Showgrounds, Ceney
053 9481077
087 1151773

Email From Mark Boland

Mark Boland profile: www.teagasc.ie/contact/staff-directory/b/mark-boland/

Hi Damien,

Just logged back in with my username and checked the functionality of the application- Everything seemed to working as I expected.
Very easy to use with continuous updates on the reports page.
I have just printed a reports page which printed very well (clear and understandable for farmers).
This application can be considered both advisor and farmer friendly which has given it huge potential in the advisory industry.

Kind Regards,

Lisa Murphy
0761114184

Email From Lisa Murphy
lisa.murphy@teagasc.ie

Apologies for the quality, emails can be forwarded on request.