ERDC EL
Moderator: Courtney Chambers
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Courtney Chambers: All right. Next I would like to introduce our speaker Mr. (Tim Welp) with the ERDC Coastal Hydraulics Laboratory. Today (Tim) is going to be talking to us about DREDGeABility – a new online tool that acts as an e-consultant – an electronic consultant -- identifying dredge types appropriate for different types of dredged material. So at this time (Tim) I'm going to give you the presenter rights, we'll enter listen only mode and you can begin.

(Tim Welp): Thanks for the introduction Courtney. Good morning or afternoon everyone. Today's webinar is on the web application called Technical Factors in DREDGEeABility or as it's more commonly called DREDGABL. Before getting started, I'd like to acknowledge gentlemen who were critical in this development. Dr. Bakeer of Intertek PSI who is the logic guru and also in memory of Joe Spigolon was an expert and a gentleman in the world of geotechnical engineering.

DREDGABL is a web application available to everyone that can get on the internet. And conceptually it's an electronic technical engineering consultant for dredging. So if you enter in your sediment characteristics of what you want to dredge, it gives you an idea of how well different types of dredges will work in that particular sediment.

So here's an outline of today's presentation. Because DREDGABL is a knowledge-based expert system, I'll give you some background information on how it's structured and then I'll describe the development of this web application.

And after that I'll walk you through a PowerPoint presentation dredging analysis example to illustrate how it works and what it can hopefully do for you. And next – if the stars are in alignment – we'll do a live demonstration with your input – the audience – so before we go to live mute and you're unmuted, please turn down the Led Zeppelin or whatever you're listening to so we can all hear and then I'll close out with a summary.

So as I said on previous slide, DREDGABL is a knowledge-based expert system and it uses artificial intelligence or AI to answer questions. So AI is the computer software that mimics both subjective and objective reasoning of the human mind and then the hardware side of AI basically physically carries out that reasoning.

Here's some different examples of AI applications that range from the puzzles and games over through to the virtual reality applications. And this webinar will be cool as long as you don't get me started on the Skynet or Cyberdyne scenarios.

And since I said that DREDGABL is a knowledge-based expert system. We'll be focusing in on that system classification. So knowledge-based expert systems are developed as a way to preserve knowledge and the experiences of experts in the respective fields that's being addressed. And the more efficient systems employ a user friendly interface that allows easy interaction between both the user and the knowledge base.

And the system's reasoning or logic if you will uses expert derived rules to mimic the human thought processes. These rules can incorporate and process a number of different mechanisms – that can include judgment, experience you've gained in the field, empirical rules of thumb, equations, and experimental evidence. There's a whole host of different mechanisms that can

be incorporated into knowledge base and all with the goal of trying to solve the kinds of problems that normally require the human expert.

So the knowledge-based expert system generally consists of two types of sub-systems. You've got your knowledge base and then you've got a reasoning mechanism or some people call it inference engine. And so the knowledge-based sub-system component represents the facts about the world and the reasoning mechanism represents the logical assertions of the conditions about that world and it's usually represented by if-and-then statements or rules.

And so basically a user inputs a problem description, it's processed through the two sub-systems and the analysis comes rolling out.

So knowledge-based expert systems are applied and some people misapply the application name, but these systems are applied to a wide variety of different types of problem domains such as things like medical diagnosis, financial analysis, and factory production scheduling.

And once the system is developed, it should be verified in real world applications by outside subject matter experts. And especially in those applications that would involve your personal medical or financial decisions! And then once verified, these systems can be used confidentially to preserve and transfer that knowledge. It can also be used as a training device and it can also enhance the education making processes like in this case -- on this webinar – you know – using what types of dredges in what types of soils.

So in this slide I'm going to transition start to talk about the development background and use of DREDGABL. On this slide you can see a photograph of a DREDGABL 1994 user's guide that was generated back in the old Dredging Research Program (DRP) days. So DREDGABL has been around

for at lest that long. And this work was subsequently built upon the R&D that was contained in this 1993 technical report that talks about geotechnical factors and dredgeabilty of sediment.

Now one of the really ambitious goals of this R&D effort was to develop a Corps standard set of dredging descriptive terms and a brand new classification system for identifying dredgeabilty of sediments in dredging projects.

And then here you can see some of the descriptive terms that were generated during this R&D activity to cover properties of the excavation, sediment transport, and placement process of the dredging. And now while the Corps' standardization effort never materialized, you'll see these descriptive terms were incorporated into DREDGABL and then, as we will see– as we get into later slides and the live demonstration hopefully that you'll see where these descriptive terms will come into play.

So when DREDGABL was developed, it was designed to serve as kind of an electronic geotechnical engineering consultant – if you will – that provides guidance on the dredgeability sediments that are characterized in the typical dredging contracts.

And we'll define dredgeability as – I'll just read it. The ease at which an underwater soil or rock can be excavated, removed, and transported using specific dredging equipment and methods.

. The suitability of a specific type of dredge or specific project depends on a wide variety of parameters. But DREDGABL only addresses how well a specific type of dredge can work in a specific type of sediment.

The other site-specific conditions like wave height, currents, dredge material, transport distances, etcetera, etcetera are not incorporated in this dredge suitability analysis.

Oh yes and I also wanted to mention here that -- while a debris classification is included -- that DREDGABL doesn't do competent rock or coral but it will do a rock and coral fragments.

So DREDGABL is intended to be a training and or a scoping tool and not -- and I'll repeat this -- and not for use in formal engineering designs. Because when I use the term scoping, I mean to apply that it's even more general or approximate than the screening level tool.

It looks at it in terms of dredge suitability defined in a range or – even a region – of general suitability with respect to sediment type. And the intended user base includes both Corps and non-Corps dredging project stakeholder personnel. Then when the knowledge base – like I say – the knowledge base is the facts about the real world and those two subsystems components' knowledge base was built on the results of a literature search that had interviews with dredging subject matter experts and then subsequently -- after the software was developed -- it was verified through field trials and workshops.

In the beginning I said about how AI can reflect both subjective and objective human thought processes. This the application could inherently contain some subjective reasoning from from the programmers. So when the original program was released what back in the 1990s for the early Windows MS-DOS platforms, there was relatively limited use by Corps or otherwise personnel.

So here we have a graphical time series of the development of DREDGABL. Like I said previously -- in the early 1990s -- the Dredging Research Program contracted with SJS Incorporated and the University of Tulane. And that's where Dr. Bakeer worked at the time. The Corps contracted with them to develop the program and release it for Windows 3.2 and MS-DOS platforms.

I saw DREDGABL demonstrated back then, yes I am that old, -- but I was impressed by it. And the Dredging Research Program invested hundreds of thousands of dollars in its development but it wasn't being used. So back in 2008, we secured funding under the Dredging Operations and Environmental Research -- or DOER program – to update DREDGABL use on the XP platform.

So we installed it on the DOTS web site and it was in a downloadable version at the time. And we got a couple people – both inside and outside the Coprs – to use it, but inevitably Microsoft marched down the road with new versions to make more money, and we saw DREDGABL again fall by the wayside.

And then we got a whole new plan. We went down to the Mobile district Spatial Data Branch and we worked with them to provide DREDGABL as a web application that resides outside our firewall. So it's available to anyone with internet access.

So now DREDGABL is available both on computers and smartphones to anybody that has connectivity. On this slide you can see the web site address you can directly go to or you can search for DREDGABL in your browser and hopefully it should show up. Otherwise you can go to the DOER or the Dredging Operations Technical Support or DOTS web site to access it. And it's also available to corps users on our CE Dredge Enterprise Database.

All right. So before I go into the canned example of DREDGABL, I want to show you this flowchart that conceptualizes the flow of this logic -- and hopefully you can see the cursor -- but the user will input the sediment type – we'll be looking at either gravel, sand, inorganic finds or organic finds or other. And this is where the debris -- coral, rock fragments classifications reside.

So when we get into the non-cohesive sediments – gravel and sand – it will ask you these questions – "What's the gradation fineness, relative density , grain angularity?" these inputs go into the knowledge base,then the output is dredge suitability for hopper dredges, mechanical dredges (both clam shell and backhoe) and pipeline dredges.

We have a cutterhead, we have bucket wheel, we have dustpan. And then we also output some of the slurry or the condition of the sediment as it arrives into the placement area.

So right now then we're going to just pretend we're opening up the DREDGABL web site. And here you can see this is the opening page on the web site. I'd like you to notice – again I'm harping on it but I don't want anybody coming back saying, "(Tim) your program wrecked my project." This is used only for scoping or conceptual-level applications only. Like I saidthis only evaluates type of sediment – suitability of a specific type of dredge – not considering if a 10 foot wave is going to be in your project.

So we'll begin evaluation and that will ask us, "Well what's the general sediment type that best describes what's going to be dredged?" And as I said previously, we range down from special through the gravel, sand, organic finds, and inorganic gravel finds.

And throughout this application, there will be discussion bars. So if you are relatively new or you haven't looked at a specific technical aspect for a while and you want clarification, hopefully we've been able to include additional information to try to clarify that.

So let's pick inorganic finds for 10 points and so that in turn – the next screen that opens up – it will ask you what's the Unified Soil Classification System classification. And you'll notice -- on the lower left hand corner -- there will be a back button and a home button so in case if you want to start over again or you want to go back to these preceding slides you'll be able to do it relatively easy.

And then what we – I think we picked the lean clay. So let's say we're going to look at the lean clay – the sandy lean clay maybe with some gravel.

So -- in turn -- the application will take you and it will ask you which of the following of relative consistency -- best fits the sediment being dredged. You can look and it will take you all the way from the very soft to the hard sediments, and you have the option of selecting "unknown."

And then, as I a mining engineer that had rock mechanics, not soilmechanics – relative consistency. We can go back in and hit the discussion button, here we can go in and start to give you more detailed description just what relative consistency of cohesive soils is. And then it will give some background – you know – how does it correlate to standard penetration test?

So if we go back – got a little better idea. And this is where it can be used as a training tool for somebody that doesn't know a whole lot about dredging or didn't take soil mechanics like myself.

And so let's say that that we're just going to go for a medium 50 to 100 kilopascal of sediment. So right now we're in organic finds with medium consistency and that in turn -- that application -- will take us into this page which asks you, "Well what's the plasticity index?" I say, "Oh boy, okay."

Plasticity index – let's see – this is telling us PI of less than 22 will not form clay balls nor will be sticky. But if we got a PI over 38, it tends to be sticky and it could have severe clay ball formation.

So we'll pick a medium range – 22 to 38 – just get some more additional information – what liquid limit minus the plastic limit. Like I said this is part of the training or to be able to go back and refresh your memory on what it is.

So we'll go with the medium range – 22 to 38 – for the plasticity index. And that in turn get us where we want to be and what information we want to review. What dredge do we want to try to use on our dredging project now that we input our sediment characteristics?

I think what we're going to start out – let's see if the project could use mechanical dredge. So once you select mechanical dredge this application will immediately take you right into this page right here. So having input sediment data – looking at the suitability of mechanical dredges.
If you're interested and kick the tires on this application or if you have any recommendations we're currently going back in and updating all the old references for the new ASTM testing, etcetera, etcetera.

But you can keep going down the listing for clamshell. It's fairly hard digging – got a drag line – same same or a power shovel. Now I'm getting into the excavation properties. This is where the work back in 93 when they were trying to come up with standardized descriptors and a classification system.

These came up with descriptive terms, cuttability, flowability, scoopability, scourabilty and suctionability.

But I don't think you've seen those terms used in any textbooks or engineering regulations because these descriptors didn't really get implemented as standardized Corps terminology. But for our purposes, I think it gives us a better qualitative perception on just what this type of sediment would do if a mechanical dredge they talk about for cuttability -- fairly easy cutting -- medium strength.

For flowability, it will probably result in stable to medium bank heights. That gives you I think a better feel of how the dredge that you're inquiring about – what kind of bottom it would leave and give you a better idea of how to operate it.

So let's say the mechanical dredge is too expensive because its too slow. Maybe we'll try a hopper dredge on our project. So again hit the hopper dredge tab and away we go. So for the same sediment, this application gives us the suitability for hopper dredges.
. If you did have a plain suction hopper dredge it's not suitable because the sediment is too firm to be suctioned easy. But with our conventional trailing arm hopper dredges, it will be easy excavation but it would be better if we used jets or rippers and to get an economic load and it would have high overflow losses.

And again the dredging descriptors will give you a better idea in the scourabilty say where it says very low. It gives you the insight of too much clay cohesion to erode, etcetera, etcetera. And where it says after removal it gives you an idea of the different – of the pumpability or the turbidity.

So one last time, and since the majority of Corps dredging over 60% is done by pipeline dredges, we'll go take a look at a pipeline dredge. Bucket wheel – not on any Corps projects but for cutter suction, well-suited medium cutting energy and easy pumping. For any dustpanners out there, the application says not suitable – too much cohesion to scour easily. And same same for plain suction – not suitable. The sediment is too firm to be suctioned easily.

So what we'd like to do – what we'd like to do now – is just to pull up and let's say you did that pipeline dredge and you wanted to see well what would be the sediment properties in the disposal area of that specific type of sediment going through a cutter head. Select that tab and this will give you disposal area properties where it comes up. Bulking rate will be very low to low. But that's giving bucket deposition only since you get such a wide variation and percent solids by weight or volume of a cutter head.

But this gives you some general recommendations for compactibility into the disposal site, moisture control using a sheep head roller. And then what's the sedimentation rate in the disposal area over – after a few days only sand and rocks will settle rapidly. And then what you would expect – the expected turbidity in this disposal area – 50 to 90%.

So that's – that's about it. So now we're going – I checked the site earlier. We're going to switch to a live demonstration and then Courtney if you want to take it off mute, what I'd like to try to have some audience participation and those of you who know your dredge, let's pick a sediment and see if you think the answer is relative or not. Could we try to unmute, Courtney and get some input?

Courtney Chambers: I will. Here we go.

(Tim Welp): Anybody out there care to start off?

Operator: You are now in interactive talk mode.

Courtney Chambers: Okay. So now if you unmute your own phone line you should be able to participate.

(Tim Welp): Somebody take a shot. You can remain anonymous. Disguise your voice.

Courtney Chambers: What do you want them to tell you first, Tim?

(Tim Welp): What kind of – what do we want – what kind of sand. Give me input. Got a project coming up? Let's take a run through and see what it tells you compared to what your dredging engineers and cost estimators are telling you. Any takers? Otherwise it will just be me going through one or two examples, see if we can break it.

(Tom Smith): I'll be a taker. (Tom Smith) here.

(Tim Welp): Oh man the Hawaiian component.

(Tom Smith): Yes sir.

(Tim Welp): What do you – what do you want to go for 10 points?

(Tom Smith): Save me some money.

(Tim Welp): What kind of sediment do you want to dredge through?

(Tom Smith): Silty.

(Tim Welp): Going for silty. So organic let's see. You want organic or inorganic?

(Tom Smith): Inorganic.

(Tim Welp): Going for it. All right. Silt no. Where's silty clay.

(Tom Smith): Clay. I'm talking about Port Allen Harbor right there in Kauai.

(Tim Welp): All right. All right do we have an idea how – what's the relative consistency?

(Tom Smith): Very consistent. river sediment so it's very consistent.

(Tim Welp): Okay so we want to go for say it's very stiff?

(Tom Smith): No. Maybe I'll take back my clay. Let's just – it's not – it's not cohesive so let me take back my clay.

(Tim Welp): Okay so we want to go back.

(Tom Smith): Can you go back in this thing?

(Tim Welp): Yes . Just hit the button. I'm sorry I did it too fast maybe for it to follow. So we'll just hit it with straight silt.

(Tom Smith): Yes.

(Tim Welp): Roger that. And what kind of consistency if you take it up – moldable say a medium, stiff, very stiff? Or if you don't know, it assumes like an average – an average stiffness so. You want to say medium? Is it a maintenance job?

(Tom Smith): All right.

(Tim Welp): Roger that. All right. What you leaning toward? What type of dredge?

(Tom Smith): Hopper dredge.

(Tim Welp): All right the hopper dredge. Oh yes. She's going to turn and burn. Easy excavation. I don't know – I think she's got some scarification teeth but it should be – should be relatively straight forward as per this application's analysis. So cool. Do I get to come over and watch her operate?

(Tom Smith): You probably have to talk to the captain.

(Tim Welp): So to just – to just go back and if we went back and did a rehash, we went organics, went silt. Let's say we would have picked – let's say if we would have picked a stiff 100 to 200 kilopascal sediment – wanted to know what the hopper dredge was – if you had that type of information it's still saying easy excavation and as long as you have rippers. Anybody else want to take a shot – different type of dredge? Any dustpanners out there?

Anybody for cutter head?

Man: What do you want to do with the cutter head Tim?

(Tim Welp): Well maybe how about if we try – let's see how good just for the heck of it – let's go special. I've played with this, I've tried to break it and it hasn't broken yet.. But I'm going to try to dredging boulders with a cutter head.

Man: You know they don't make rocks in Louisiana right? We've got to barge them in.

(Tim Welp): We'll go back – just do a cutter head for Louisiana – most down there organics. Let's try – let's go for a clay – real hard clay see if you can cut through it.

And oh we don't have – we don't have clay – see if it's a real – it's going to be a real sticky. Go for a clay balls forming in the pipeline and so cutter suction is still well-suited, fairly high cutting energy and easy pumping. And oh let me guess the majority of dredging – cutter head dredging – down in Louisiana – between that it's even more than hopper dredges now right?

So our system works. So that's pretty it unless somebody else has any requests, just want to drive you through the application. And there is – I forgot this. Like I said I'm still learning the difference between a plasticity index and liquidity index. But if you have an organic silt and you don't have the plasticity index, it will actually incorporate a liquidity index. For those of that know the difference between the two for the cohesive sediments that's an alternative evaluation option.

So then we're going to get out of our live demo and just go into conclusion just to recap. Again this is for scoping level applications only. It was intended as a guide or computerized mentor that people that have limited experience in dredging or you can also be used for your new people coming in. And then actually for your dredge heads out there, if you just wanted to have a check on what you think or will not work, you could use this application as a check on yourself.

As also previously mentioned, this is a work in progress. It's almost – almost completed. But if you play with it and you have a recommendation that how we could possibly make this better – more applicable
So with that, any questions out there?

Courtney Chambers: Make sure your phone lines are unmuted or if you'd like to utilize the chat feature you can type your question.

(Tim Welp): All right

Courtney Chambers: Give you a few more minutes. A reminder also that if you like a PDH, I've received several requests. So if you have not mentioned that yet and you would like to receive a PDH please let me know by sending me a chat message and I'll put you on the list. (It's a really quick tool. I like how you shared you just click back and forth through different scenarios very quickly. It's not a super time intensive tool. I guess that's ideal for scoping.

(Tim Welp): Thank you for that. That's how we design it. All right.

Courtney Chambers: Any – any last questions, participants? All right (Tim) well thank you for sharing. Do you have any final comments before we wrap up today?

(Tim Welp): Just – just that if you get a chance to play with it, give me some comments. We're striving to get better product out to you. Thank you much for your time today and listening.

Courtney Chambers: Thanks Tim. Thank you for sharing this tool with it and making it so useful. Participants, thank you for joining us to make for a successful webinar. Please continue watching for upcoming notices for additional DOTS webinars

through email. And we'll look forward to learning again with you soon. Have a good afternoon.

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