Welcome to my presentation of reduction of cam programming time.

AGENDA:
First of all I would like to tell a few words about my self.
My second point is 3 min. about where I work. The department, before, today, and tomorrow.
Point 3 is CAM programming where the geometry is controlled by expressions list in NX.
Then we have CAM programming of an unparametric solid where, the CAM strategy is already known.
In point 5, I will show how we use import for solution of some issues.
Finally I would like to demonstrate for you how we use the cam program for solving these types of tasks.

1.
My name is Hans-Jørn Kristensen and I work as a tool constructor and toolmaker at LEGO Company in Denmark. I have worked with tool construction and production of molds for the last 26 years. I have worked with CAD/CAM for 18 years (started with Unigraphics 7)
As a cam specialist I educate my colleagues in cam programming and upgrades.
The reason why I am here today is because of my colleague Christian Wissing Kruse.
He encouraged me, to come here today to tell a little about what we otherwise work with in the department. For example saving time in CAM programming by automating part of the programming.
One of the results is a spreads sheet to control the tool data base. You can hear more about this on Wednesday at o'clock ?? With my colleague Klaus Gorm Jensen.

2.

LEGO Company was founded in 1932, as a family owned company. They made toys of wood. In 1958 they started the production of the plastic bricks as most of us know today. We are 4500 employed world wide. Every hour, 2 mill. LEGO bricks are produced.
In 1999 we were a department at the LEGO Company with about 40 employed.
We constructed and made 300 prototyping moulds in soft metal.
In 2002 we started making productions moulds in Billund in Denmark. The reason was to save money and lead time.
That was the beginning of standardizing and modularizing of our moulds. Standardizing and modularizing of all these different parts for the moulds, give us the possibility to automate the manufacturing process.
Here I think about cam programming, milling strategy, tool list and fixture
In the cnc machine and so one.
In 2005 we changed a part of some of our milling machines. Now we have 3 five axis and 3 three axis Mikron milling machines, all with Heidenhain controller.
Today we are 40 employed. Most of them use cad and cam for constructing and milling the moulds. Nearly all of us do all the processes in manufacturing of the moulds. Therefore it is very important to make it as simple as possible.
Now we produce 120 production moulds. They have between 2 and 64 cavities. We also produce 120 prototyping moulds in soft metal.
It is our dream to make the cam programming as fast as when we make a RPT element. 1 hour for programming and preparation of the parts, and the next day the mould parts are manufactured.
Maybe this is not realistic, but I know we can get closer than today.

3a.
Now I want to tell about what we do to save time. And I will show some examples.
In one of our mould types we use 3 bricks in which the runner channel is made.

Here you only see one of them.
Every time we make a new mould we have to drill some holes, milling the runner channel and milling some conical holes.
We have to change the geometry depending of how many cavities and the position of them in the mould. We are able to change this with the expressions list in NX. I will show it in the demonstration later. With this template for mould construction we are able to automate construction and cam for 1, 2, 3, 4, 6, or 8 gates in the runner channel.

3b.

The milling strategy is the same every time. As we are using the same construction template part every time, we are able to update our cam template part. We only have to open the cam template, make a save as, open the component as the new mould construction.

3c

Then we have to update session and generate the tool path. After post processing we are ready to go to the CNC milling machine.
Before we used the template it took 1 day for programming and milling. Now it takes a ½ hour for programming and 1 hour for manufacturing.
It saves a lot of time, but there is also another important thing. It is the quality. When we use a template, we always use the same data for manufacturing. Feeds and speed, side step and dept step and the milling strategy, are always the same. In that way we ensure that every one of the 40 employed, are manufacturing the runner cannel in the same way.
When you are programming the template you must think about which type of cam operations you want to use. It's for example not possible to update a drilling operation using "all holes on face". Then you have to select the face again after updating the solid. Cavity mill operations are good because the software always calculate the updated solid. In this task I also use ZLEVEL operations, but then I have to link the brick into my cam template. In that way I can select the cut area and later update the solid and the operation when I want to use the template for another mould.

4a.

Unparametric solid and known cam strategy.

This is an ejector plate. Most of them are unparametric.
Also in this case, there are some known elements. It's nearly the same story.
Make a CAM template. And next time you want to mill an ejector plate, you open the CAM template. Make a copy using save as. Add the mould construction into the template. Make a few selections; generate the operations and post process the tool path.

4b.

In the case of modularizing we know the dimension of the solid and the position in the mould construction.
Therefore we can use the same, special made and easy to use fixture, every time in the cnc machine.
It's easy to add the construction to the cam template, because we use absolute position X Y Z zero.
95 percent of the jobs we can mill, only by using drilling and cavity milling.
The programming is a few selections and a generation.
Again I have to say, saving time is good and necessary, but to be able to make the same quality every time that's gold.
In this case I have made a blue solid as you can see on the first picture. This solid I use as my work piece in the cam template. After I have linked the ejector plate, I unite the plate with the blue solid and then the ejector plate is work piece. The unite will also close the prefabricated holes. The cut level, material and clearance plane are also inherited from the blue solid.

5a.

CAM programming by using import.

In many of our moulds we have holes like this picture. It’s a hole for a standard insert.

It doesn’t make sense to program the same again and again. Therefore we have made a macro to import a part with cam operations. It’s not very elegant but it works.

In the imported cam part we only have the geometry and the milling tools we need. We only import once. If we need more than one hole, we use transformation of the operations.

The import macro makes a subprogram and replaces it in the main program.

You can see it in picture 2.

The macro also replaces the operations to the right MCS and machining method.

6.

Demonstration in NX4

3. CAM programming of the runner channel

I will start to show you one of our standard templates for mould construction.

Here you see a runner channel for 8 gates.

I want to change it to 4 gates. I choose expression list and here I can change it from 8 to 4.

I also want to change the position of gate 1. From X 8 to X 15, and Y to 18.

I save the changes and now we say the mould construction is finished. I save the part and close it.

I open the cam template part. Here you see a runner channel and 21 gates. To be able to mill all the different combinations of runner channels and gates automatically, I have to select all of them for example in ZLEVEL operations.

I will open component as my new mould construction. After that, I update session and we see now the same runner channel, as in the mould construction.

We want to generate the operations and therefore I change to the manufacturing module. I select a few operations and generate them. The system says there is some suppressed geometry. I say yes its okay, there is some suppressed geometry. Here I only use 4 of the gates.

I don’t want to generate all operations, but you can see we only have to generate the operations. Everything is selected.

After a post processing we are finished.

Demonstration of point 4

CAM programming of an un parametric solid where the CAM strategy is known.

I open my mould construction and here I have an ejector plate. I open my CAM template for ejector plate. I use add existing component and then I have my plate in the cam template. We need link geometry also. Remember to make a save as. Now I want to unite the blue solid with the ejector plate and then I change to the manufacturing module. These 4 operations are enough to drill and mill the holes for the ejector pins. Only in drilling I have to select the holes. The milling data, MCS, clearance plane and so on are defined.

I select the holes on the bottom face. It's easier. First a blank and then select all holes on face, and do it once again.

Then we have a cavity with a ball end tool for roughing. An other cavity using an end mill for finishing the bottom. This operation will remove the radius in the bottom of the holes. In cut levels you se a dept of 2, 3, and 5 mm. We only have 3 different heads of the ejector pins. After generations of all operations we are ready for post processing.

5. CAM programming of a hole for an insert by using IMPORT.

In this block I have made a hole for an insert. In our moulds we often use standard inserts. We want to mill this hole, in the same way every time. A macro will always do it in the same way. Now I will make a macro playback. Here I have to select a position. I select the center and then I have 4 operations in a subprogram. I generate them and now I am finished.

If I want more than one hole, I select the subprogram and use transform and instance.