

PTC® Live Global

CUST 113 - Design of Configurable Products Using PTC Windchill and PTC Creo Option Modeler

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Design of configurable products using PTC Windchill и PTC Creo

PTC® Live
Global

Agenda

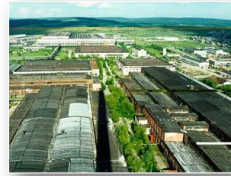
- **About Borets Company**
 - Facts & Figures
- **Products and business features**
 - ESP design structure
 - ESP system options and variants
 - Typical difficulties in manufacture preparation
- **PLM Solution**
 - PLM system main objectives
 - IT systems interaction during product design
 - Design documentation requirements
 - Configurable product structure
 - Configurable ESP
 - Automatic product classification
- **Resulting benefits**
 - Business opportunities



About Borets Company

Facts & Figures

- **1897** the year Borets began business in Russia
- **9 000** employees worldwide
- **3 500+** dedicated field personnel
- Leading ESP global market positions
- **500+** Clients served internationally
- **12** Manufacturing Facilities in **5** countries
- **10 000+** ESP manufactured annually
- **41 000** ESPs installed base
- **1 800** innovative Permanent Magnet Motors in operation worldwide
- **25** Service & repair bases in **10** countries
- **19 000** wells currently under Service Contracts



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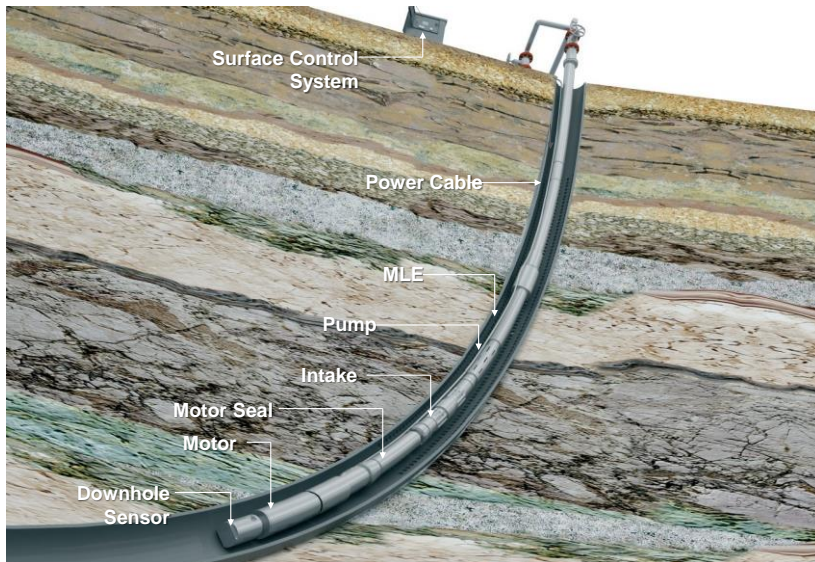
About Borets Company

Borets Global Footprint



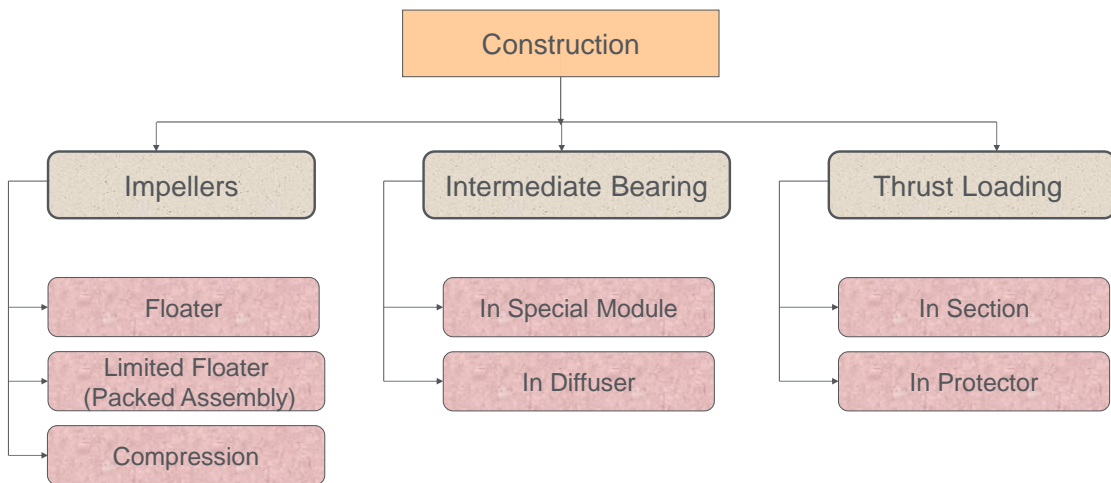
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Typical ESP System

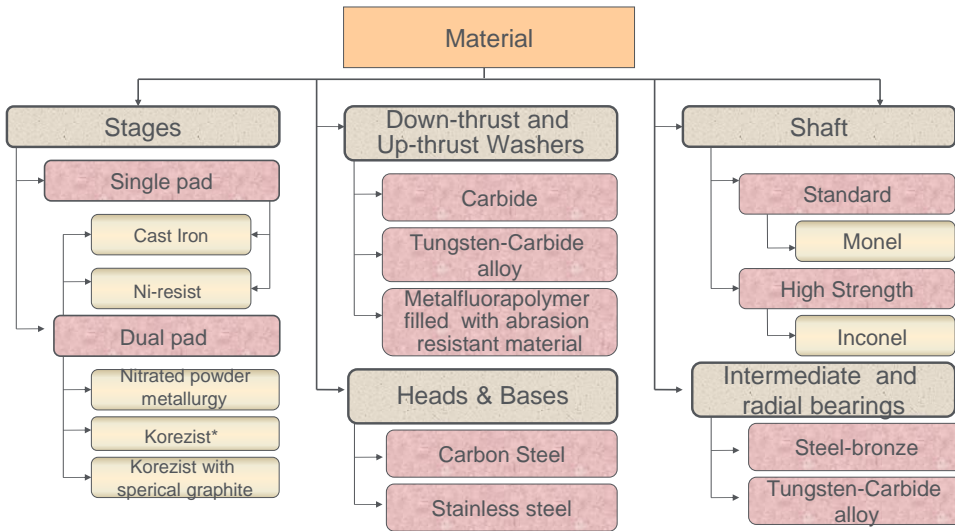


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Pump Classification



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*- Corrosion and abrasion resistant steel

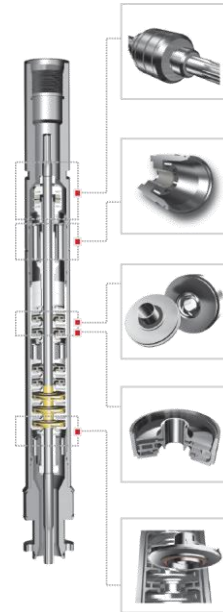
Pump-fulfillment	Pump parts	Construction							Coating of housing, head and base	
		Impellers			Intermediate bearing		Thrust bearing		Painted	Corrosion resistant
		Floating	Limited Floating (Packed Assembly)	Fixed with shaft (Compression)	In Special Module	In Diffuser	In Section	In Protector		
Standard										
Corrosion resistant										
Wear-resistant										
Wear- and corrosion-resistant										

Pump-fulfillment	Pump parts	Material														
		Stages						Shaft		Downthrust and Upthrust Washers			Intermediate and radial bearings		Pump and head bases	
		Single Pad		Dual Pad				Standard	High Strength	Carbide	Tungsten Carbide alloy	Metalfluoropolymer filled with abrasion resistant material	Steel bronze	Tungsten Carbide alloy	Carbon Steel	Stainless steel
Caston Iron	Ni-resist	Caston Iron	Ni-resist	Nitrated powder metallurgy	Corrosion and abrasion resistant steel ("Korezist")	"Korezist" with spherical graphite	K-monel	Inconel								
Standard																
Corrosion resistant																
Wear-resistant																
Wear- and corrosion-resistant																

ESP system options and variants (1 of 3)

• ESP Design

- Sizes
 - ~13 variants
- Stage types
 - ~20 variants
- Construction types and design features
 - ~15 variants
- Lengths
 - ~15 variants
- Materials and coatings
 - ~XXX variants



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ESP system options and variants (3 of 3)

• Classification

- 40 parameters can clearly describe each pump instance
- ~4 values for each property (average)

• Overall amount of possible pump instances

- Combination of 40 parameters from (4*40)=160 possible without replication

$$C_n^k = \frac{n!}{k!(n-k)!}$$

$$C_{160}^{40} = \frac{160!}{(160-40)!40!} = \frac{160!}{120!40!} =$$

$$= 8.638082057375584 * 10^{37}$$

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Typical difficulties in manufacture preparation

- **Engineering documentation**
 - Created for a limited amount of product variants
 - Drawings and BOM reports created for a groups of pre-calculated product instances
 - Up-to **2000** end-items in one design
- **Business and manufacture requirements**
 - Minimum terms of order processing
 - Quick implement of new product option
 - Single BOMs per requests



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PLM system main objectives

- **Design methodology:**
 - **Pumps**
 - Hydrodynamics
 - AnSYS
 - **Motors**
 - Wires and coils
 - Analysis
 - PTC® Mathcad®
 - **Control units**
 - Circuits and boards
 - Altium Designer
 - Cables
- **Single source of engineering documentation**
- **Design process management**
- **Manufacture process management**



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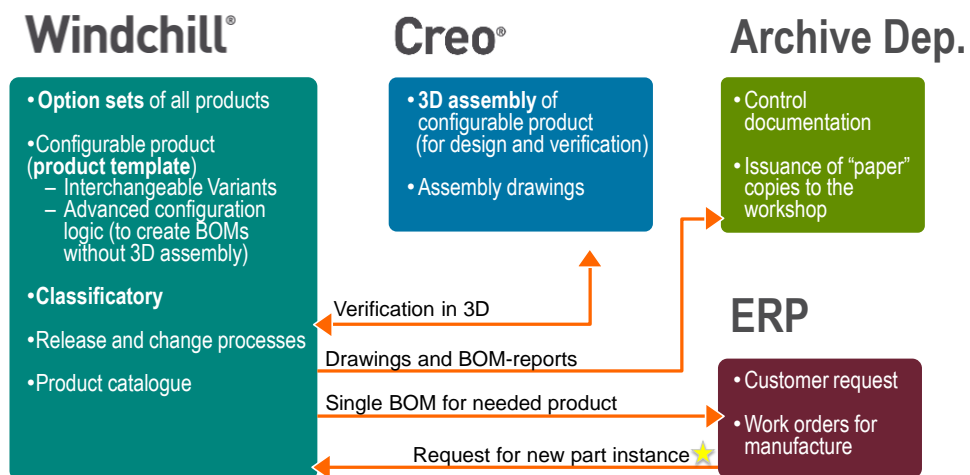
PLM system main objectives for Borets

PTC® Creo® Parametric™

- **Parameterization**
 - It allows us to select the desired instances of the overall set (possible 1037 variants)
- **Configuration management (together with PTC Windchill)**
 - Design configurable products
 - Create and **verify** new product instances using parameters

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IT systems interaction during product design

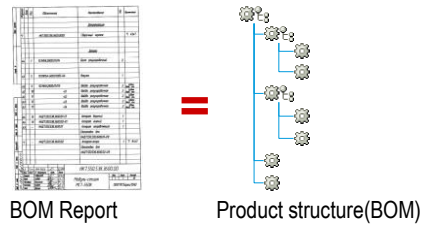


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Design documentation requirements

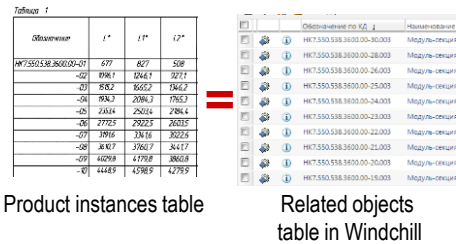
• Documentation consumers:

- Engineers
 - Design engineers
 - Manufacture engineers
- Manufacture
 - Workshops
 - Quality
- Service
 - Worldwide service departments
- Customer

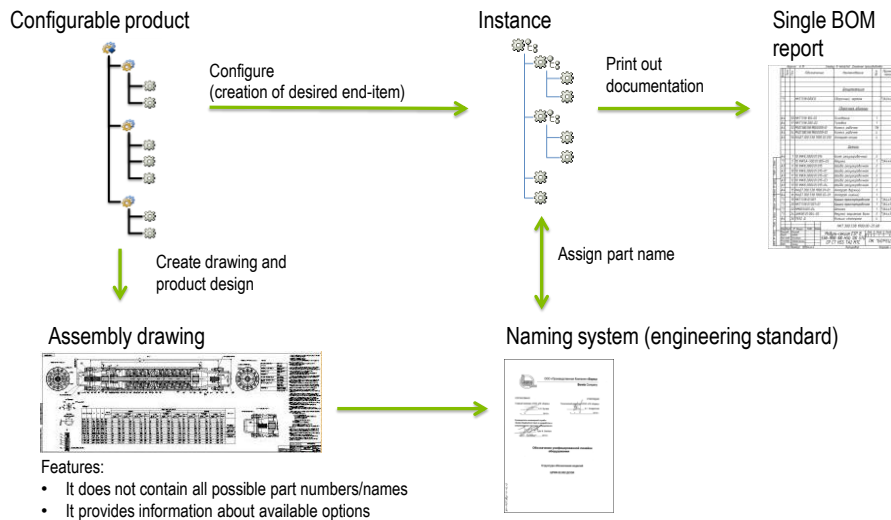


• Convenient for everyone to work with documents and lists from PTC Windchill, and not with the "paper"

- Single BOMs are printed out from PTC Windchill to workshops and customers using custom reports from PTC Windchill



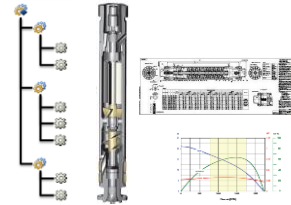
Resulting design documentation



Configurable process usage process

• Design engineer

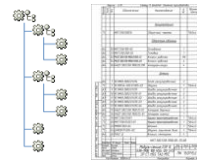
- Create a configurable product
 - With all applicable variants and options
- Boundary condition tests
- Advanced logic configuration
 - Usage options, quantity options, parameters etc.



Product "Template"

• Application engineer

- Create needed product instance by request
 - New part and BOM
 - Release new part in Windchill
 - Send it to ERP and archive



Product Instance

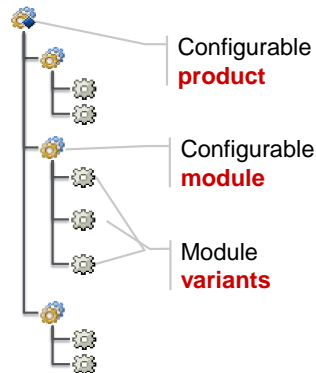
Configurable product structure

• Configurable product

- Product design with all variants
- Product is divided into "blocks" with interfaces of their assembly into the structure

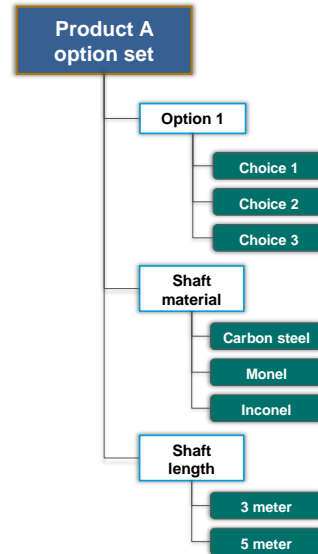
• Configurable module

- Based on interchanged all its possible variants
- Each module - it is 1 or more of its possible variants. Variants can be interchangeable with each other



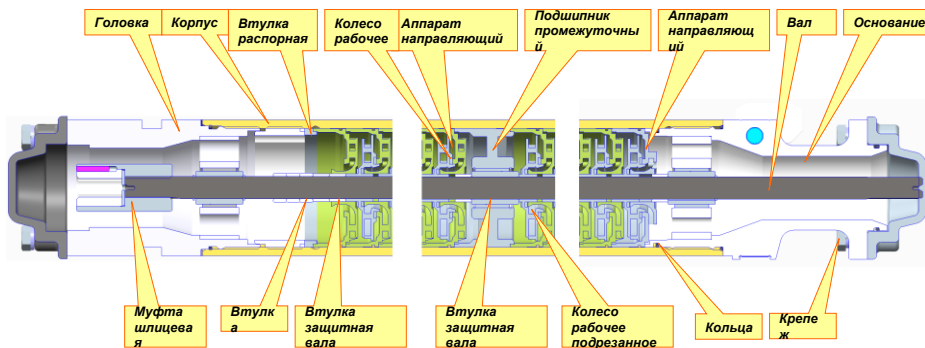
Options and Variants

- **Option Set / Option Pool**
 - A capability or feature of a product that may have several choices
 - The set of options that are applicable to the product
 - Functional characteristics of a product or its property
- **Choice**
 - Option value
 - Corresponds to parts / assembly, which must be included into product structure
- **Rules**
 - Including rules. Choices that should be used together
 - Exclusion rules. Choices that cannot be used together



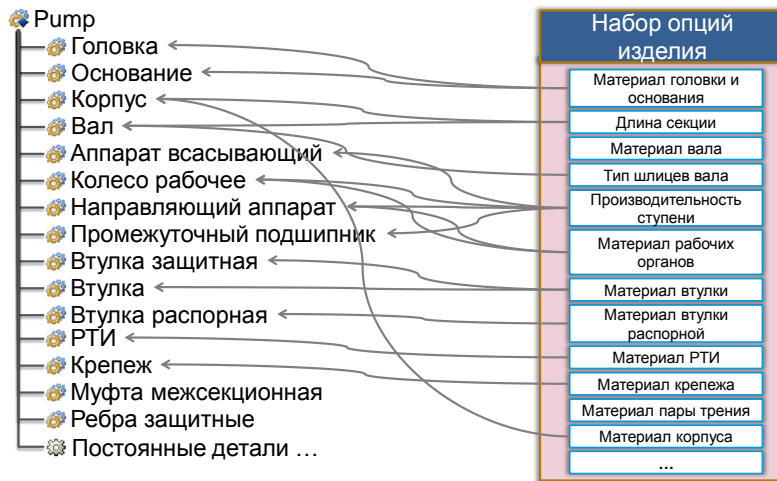
Configurable ESP (1 of 7)

- **ESP design structure**
 - Variable modules (up to 95% of all parts can be variable)
 - Contain all possible variances
 - Variances in a module are interchangeable



Configurable ESP (2 из 7)

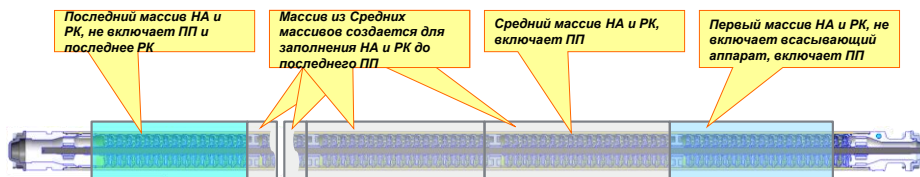
- Options and configurable modules matching



Configurable ESP (3 из 7)

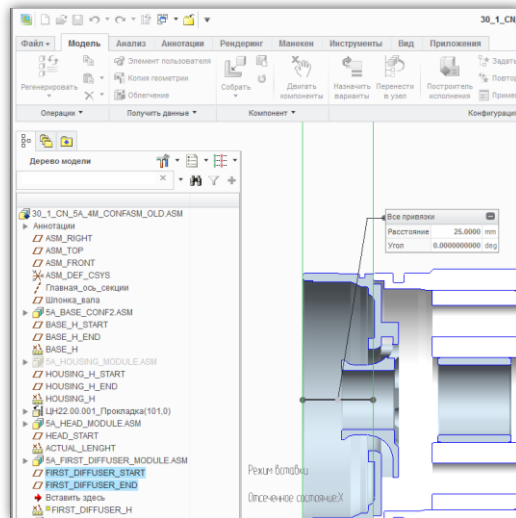
- Parametrization of assembly scheme

- Positions and relations of components are calculated based on its individual geometry and selected product options
 - Intermediate bearings and diffusers
 - Bearing count is calculated based on housing length and heights of diffusers and bearings using Creo analysis, parameters and relations



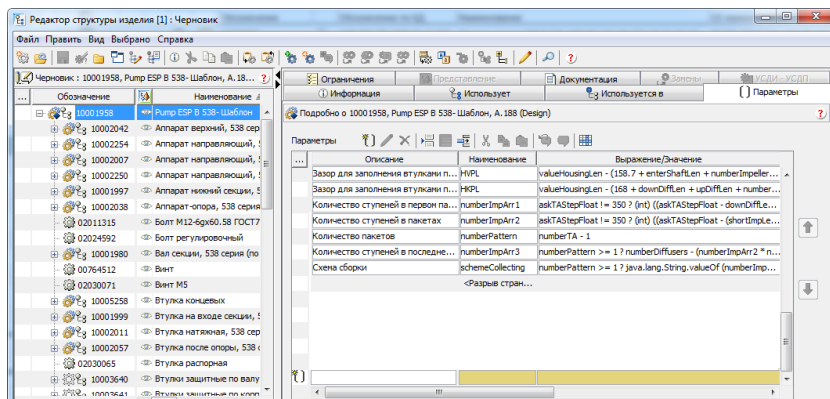
Configurable ESP (4 из 7)

- Analysis and measurements
 - Position of component and quantity calculation
- Relations in the assembly
 - The calculation of dimensional chains
 - Manage of 3D model features and its parameters (arrays, datum planes, and so on)



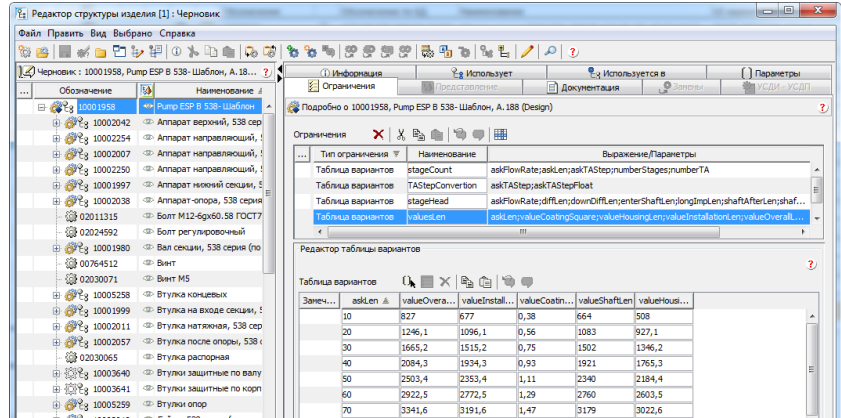
Configurable ESP (5 из 7)

- Advanced logic in product structure
 - Part usage and parameters can be calculated using relations and formulas in product structure explorer
 - Can be used without 3D assembly



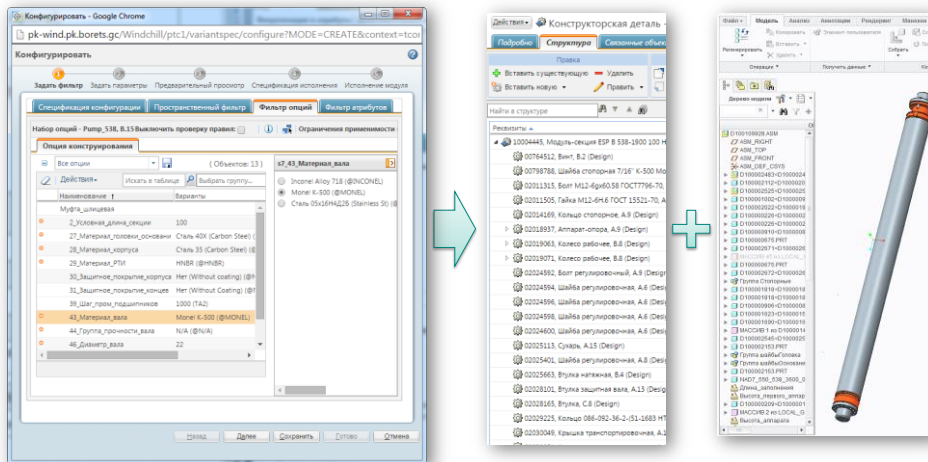
Configurable ESP (6 из 7)

- Table constrains
 - Quantity option and Usage option can be configured by table constrains. Positions and relations of components are calculated based on its individual geometry and selected product options



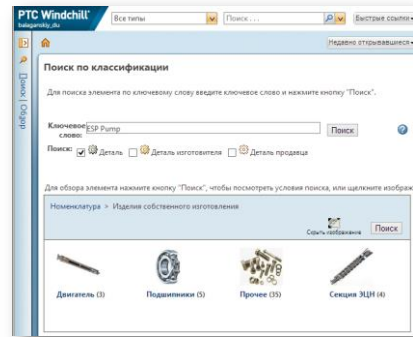
Configurable ESP (7 из 7)

- User interface or new part creation process



Automatic part classification

- **Classification is a result of parametrization**
 - The parameterization - primary classification – secondary
- **Source if classification attributes ca be:**
 - Field in during configuration process (checkboxes)
 - Measurement in 3D assembly
 - Calculated based on other parameters
 - Manual input

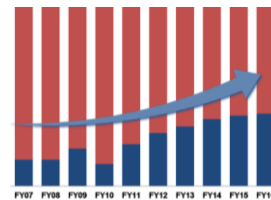


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Business opportunities

Business opportunities

- **Time reducing**
 - Reduced lead times
 - Fast introduction of new options in products
- **Quality rising**
 - 3D validation of all part configurations
 - The transition from ETO to CTO
 - Presence documentation for all product configurations



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Вопросы?

- Thank you!



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