

# Constraint Technology for Solving Configuration Problems

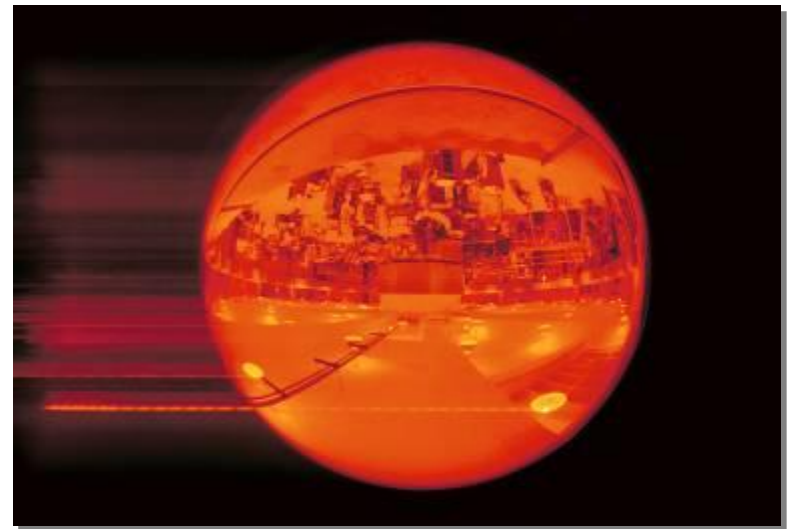
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[www.tacton.com](http://www.tacton.com)



# Tacton Systems in brief



- Global vendor of product configuration and sales configuration software and services. Head office in Stockholm, Sweden.
- Tacton Systems founded 1998 as a spin-off of SICS, after industrialization financing from Ericsson
- Tacton has global go-to-market partners such as: SolidWorks, IBM, Dassault Systèmes, Lawson, and Exact Software.



# Tacton Customers by Segment

## Telecom Equipment



## Electrical



## Medical & Biotech Devices



## Automotive



## Machinery



## Material Handling / Warehouse



## Fluid Flow



## Signs & Printing



## Building Equipment



## Steel



## Robotics



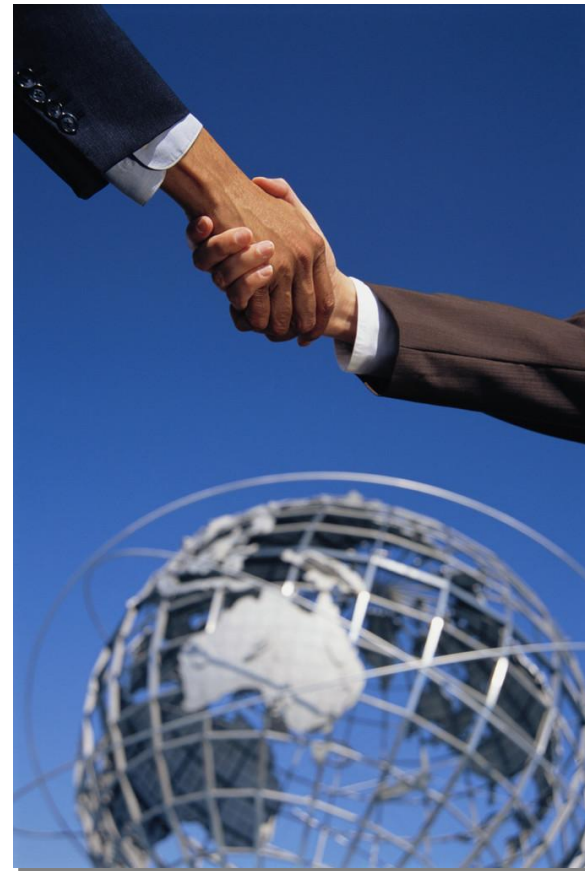
# Global Channel Partners

**Tacton has global go-to-market partners such as;**

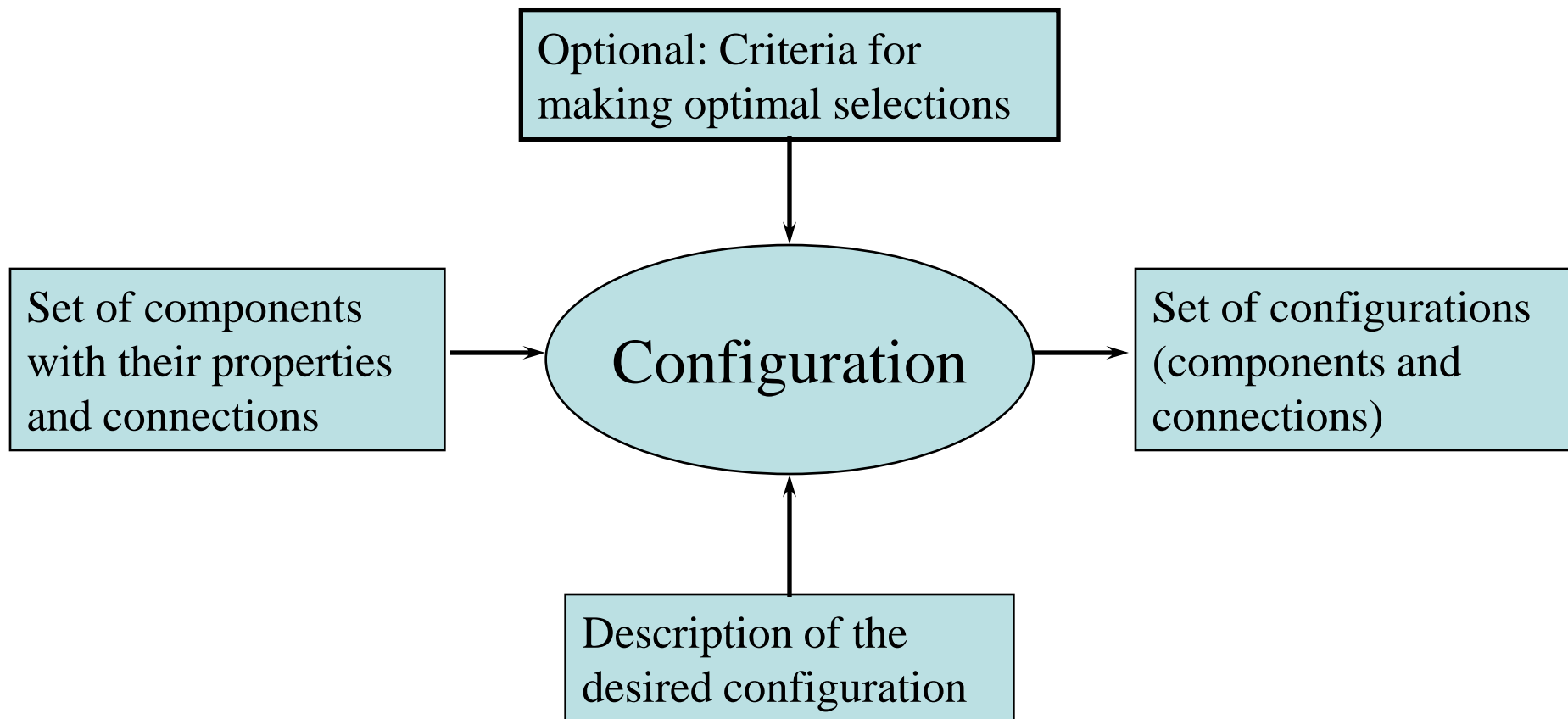
- IBM, Dassault Systèmes, SolidWorks, Lawson, Intershop, Exact Software, Jeeves Enterprise

**Tacton resellers are present in;**

- North America
- United Kingdom
- Germany
- The Netherlands
- Italy
- Finland
- Sweden
- Korea
- Japan
- India



# Configuration



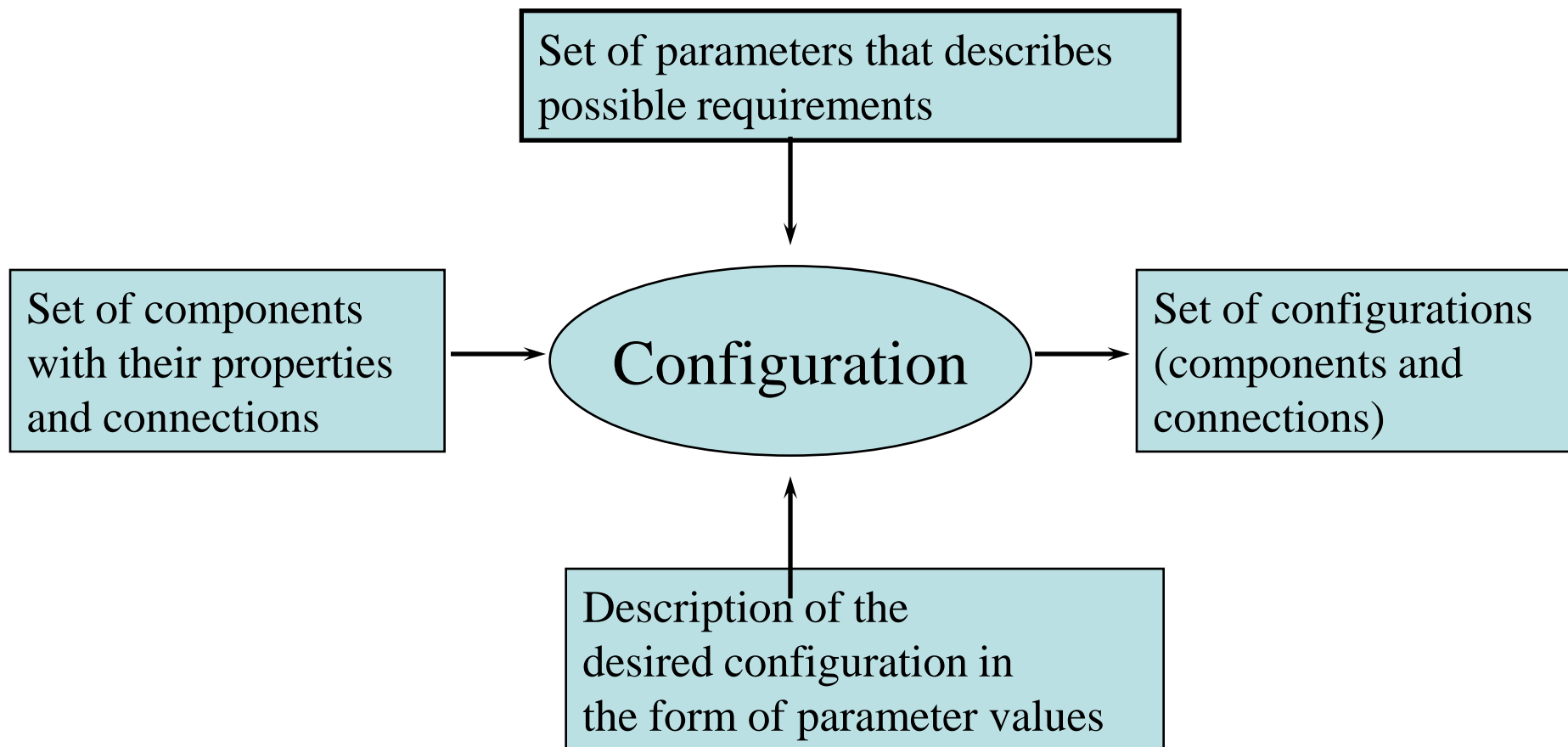
# Loose definition

- **For example say that the component set is a computer's machine instructions and the requirement is "a good operating system".**
- **Innovative design**

# To be a Configuration problem there must exist

- **Set of parameters that describe possible requirements**
  - Can be a dynamic set
- **A function can be formulated that takes the set of parameters as argument and returns a configuration if possible**

# Configuration





# Configuration Engine

- **Takes**
  - Representation of a configuration problem (model)
  - Set of values for the input parameters
- **Returns**
  - A configuration

# Additional Tasks

- **Optimal solution**
- **All solutions**
- **Incomplete requirements**
- **Propagation**
- **Explanation**
- **Conflict resolution**
- **Re-configuration (extensions)**

# Engine Types

- **Rule-based**
  - Expert Systems (XCON)
  - Include/Exclude (Trucksoft...)
- **Resource-based (SalesBuilder, O2)**
- **Constraint-based (Selectica, Calico)**
- **Constraint Programming-based**
  - Plain (ConfigIt, Baan, Array)
  - Model-based (Tacton, Ilog)

# Constraint Programming

- **“Constraint Programming represents one of the closest approaches computer science has yet made to the Holy Grail of programming: the user states the problem, the computer solves it.” [E. Freuder]**
- **The logic programming community has made similar claims since the 70’s**
- **However, most of application development is specifying how the computer should behave, not specifying how problems should be solved.**
- **But we are focusing on a single class of problems, configuration problems and for configuration application the behavior is fairly fixed.**

# Tacton Configuration Site Application (TCsite)



User

Internet

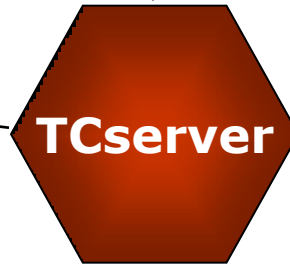
Server

- Product catalogue
- User login, -groups, -rights
- Market, Currency
- Multilanguage

- Configuration view
- Quick-info, Images
- Pop-up messages
- Document-links
- Web-links

- Shopping cart
- Customer info, Discount
- Save/Load, Templates
- Quotation, Order
- Search

- Config. Model**
- Configuration structure
  - Constraints
  - User editable fields



- Output**
- Quotation
  - BOM/Order
  - Files, Documents
  - Drawing
  - Etc...

- Data**
- Components/Modules
  - Property values
  - Special calculations
  - Images, links, texts,...



**TCstudio**

# Demo TCStudio

- **Modeling Tool**
- **Includes a runtime**

# A Small Configuration Problem

Magazine Type	Power supplied	Slots supplied	Price
1	150	8	150
2	200	15	200

Card Type	Power Consumed	Slots Consumed
1	20	1
2	40	1
3	50	1
4	75	1

# Example Request

For example you might want to find the cheapest way to allocate

- 10 type-1 cards
- 4 type-2 cards
- 2 type-3 cards
- 1 type-4 cards

Using at most 5 type-1 and type-2 magazines,



# How do we implement a solver

- **Try to find a heuristic algorithm e.g.**
  - Fit all type 1 cards in magazine of type 2
  - Fit all type 4 cards in magazine of type 1.
  - Try to fit the other cards in the magazines we now have

# Problems

- **Hard to know if correct**
- **May need lots of rules**
- **If anything change everything has to be checked/rewritten**

# How do we implement a solver

- **Figure out an algorithm e.g.**
  - Know there are only 20 magazine combinations
  - Order them according to cost
  - Take the first combination in which the card fits
    - Easy: just try all different placements of the cards

# Problems

- **Each card chooses a magazine**
- **$5^{17}$**
- **Oops**
- **Take the slot resource into account**
  - When a magazine is full we want to avoid considering placing cards in it
- **Take the power resource into account**
  - When all power in a magazine is used we want to avoid considering placing cards in it
- **Starts to get complicated**
- **Use Tacton!**

# Problems

- **Performance problems “always” solvable**
  - Search strategies
  - Efficient modeling
  - Reduced functionality
    - Incomplete consistency check
    - No optimization
    - Steps (less conflict resolution)
- **But**
  - Requires expertise
  - Makes ugly models
  - Hard to maintain
- **Sometimes easier to find heuristic knowledge**

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