ICED13
**INTERNATIONAL CONFERENCE ON ENGINEERING DESIGN, ICED13**
19-22 AUGUST 2013, SUNGKYUNKWAN UNIVERSITY, SEOUL, KOREA

# UNIVERSAL PRODUCT DEVELOPMENT – A WANT- OR WISH-BASED DEVELOPMENT TASK

**Stig OTTOSSON**
Gjøvik University College, Sweden

## ABSTRACT
To develop universal products that suit everybody is complex for which the guidelines and theories for need-based development are not designed. Instead development principles developed for New Product Development based on a want or a wish can be used when universal products are to be developed. Two successful universal product development projects that started with a wish and a want respectively are in the paper taken as examples on successful development of universal products by using Dynamic Product Development principles.

*Keywords: DfX, DPD™, innovation, new product development, universal design*

Contact:
Prof. Dr. Ing. Stig Ottosson
Gjøvik University College
Faculty of Technology, Economy and Management
Gjovik
N-2815
Norway
stig.ottosson@hig.no

# 1 INTRODUCTION

This paper has as ambition to inform about universal product development in general and to show that successful *want*- and *wish-based* product development (PD) is possible to do although there in most western larger corporations and in the PD literature exist a dominating view that without customer or market *needs*, PD projects will not be successful.

# 2 FROM STANDARD TO UNIVERSAL PRODUCTS

From the beginning of this century the concept of mass customization (e.g. Tseng & Jiao 2001) has spread which means that the market need view has been extended with satisfying single users and customers with customized products based on modularizing principles. What is known as User-centered Design (USD) has, based on this trend, experienced a growing interest to satisfy demands for each user and customer. So far that has mainly been done by using modular principles or by making multi-functional products that has every feature built in it for the user to use what she/he needs at the moment of use.

An important reason for the industrial interest in modular design is that sellers want to customize their product offerings in order to increase the value offered to individual buyers and to gain a competitive advantage over the seller's competitors (Stump et al 2003). With the development of the world wide web (WWW) a step further has been taken to let the users design their products for which there are two fundamental approaches (Randall et al 2007): needs-based systems and parameter-based systems. With needs-based systems, users specify the relative importance of their need, and an optimization algorithm recommends the combination of design parameters that is likely to maximize the user utility. With parameter-based systems, users directly specify the values of design parameters of the product.

Now a market interest for universal products is emerging based on political initiatives. One important reason for that is that the public environment consists of products and solutions that of democratic and public health reasons need to be universal so that everybody shall have equal possibilities to use them. Therefore the need for products – and public environments - with a high degree of universality is based on a political want or wish expressed as Universal Design (e.g. EU 2007).

Figure 1 shows some characteristics of the three development situations with approximate years of initiation.

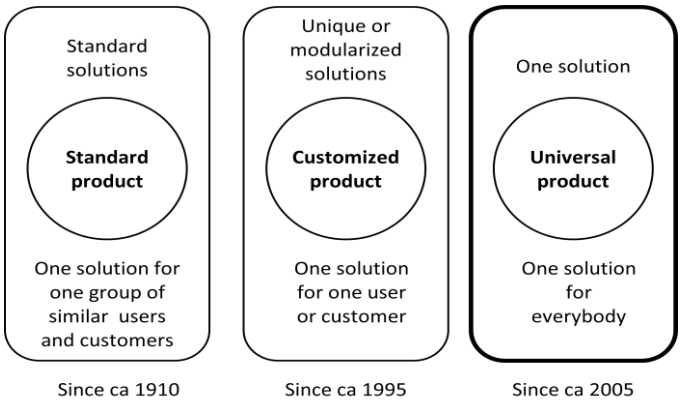


*Figure 1. Three development situations*

Thus, universal products shall be designed to be useable by everybody directly or by using surplus features that the products have built in in one single product (e.g. as for a mobile phone). Universal products can also be products that secondary users – such as nursing people - can use without changes or modifications. A nurse should e.g. be able to use a universal lifting aid for most patients and a taxi driver should be able use single universally designed comfort products for all types of passengers.

To secure that the developers develop well functioning products and environments, at least seven UD demands need to be taken care of for the product developers (Story et al 2001):

1. **Equitable Use.** The design shall be useful and marketable to people with diverse abilities.
2. **Flexibility in Use:** The design shall accommodate a wide range of individual preferences and abilities.

3. **Simple and Intuitive Use.** The use of design shall easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. **Perceptible Information.** The design shall communicate necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5. **Tolerance for Error.** The design shall minimize hazards and the adverse consequences of accidental or unintended actions.
6. **Low Physical Effort.** The design shall be used efficiently and comfortably and with a minimum of fatigue.
7. **Size and Space for Approach and Use.** Appropriate size and space shall be provided for approach, reach, manipulation, and use regardless of users´ body size, posture or mobility.

The seven demands define the degree of fit between individuals or groups and their environments, but they also refer to the attributes of products and environments that are perceived to support or impede human activities. In addition, they imply the objective of minimizing the adverse effects environments may have on their users such as stress, distraction, inefficiency and sickness. They shall also give pleasure in use (Jordan 2003) seen in a broad scale such as creating a good feeling when they are used.
As for standard products and unique products, a universal product can be a software or/and hardware. A 100 % universal software product is possible to develop (Björk et al 2007). Hardware products are more difficult to develop to get that level of universality and multi-functional products will often collide with at least demand 7 (think e.g. of a Swiss army knife).

# 3 THEORY

## History

Based on and reflecting on the carrying through of a large number of New Product Development (NPD) projects the last 20 years we have found that it is meaningful to distinguish between three rather different backgrounds; needs, wants, or wishes (Ottosson 2006, Holmblad 2007, Björk & Ottosson 2008). In short we summarized the differences between need-, want-, and wish-based PD as are shown in table 1.

*Table 1. Three types of backgrounds for product development causing different circumstances for the NPD work (Björk & Ottosson 2008)*

| Driving PD force | Characteristics | PD target | Planning | Stable conditions |
|---|---|---|---|---|
| ***Need*** | Knowledge and solutions exist to re-use for an existing need | Fixed | Fulfil plan | Yes |
| ***Want*** | Knowledge and solutions are incomplete to solve a new want | Moving | Adopt to the situation | Partly |
| ***Wish*** | Important knowledge and solutions do not exist | Vision | Create, make and test | No |

Our notice had been that for NPD projects based on a market need the time factor is crucial as the need/problem already is there and that the risk of competitive solutions to occur is great because of that many competitors have or can get the same information. For need-based NPD the price is the second most important variable as many similar solutions can appear on the market meaning a price competition. In turn that means a demand for low PD and production costs as well as for effective logistics. CAE (Computer Aided Engineering) is key to efficient and effective development using known knowledge and solutions to work further from. To find out market needs the most used method at that time seemed to be the QFD method (Quality Function Deployment) combined with a representation in the form of a "House of Quality". [Today not often QFD and House of Quality are mentioned in practical work.]
Our notice had also been that for the development of new products or other solutions that are based on a want the time factor does not have the same importance as for need-based development. Investigation tools, such as QFD and market investigations, seldom can be used of different reasons for want-based NPD (Ottosson 2013). To find out *wants* for a near future - as well as to create *wishes* for a more distant future - unstructured interviews and dialogues with people on the market was suggested. Other ways of finding *wants* and *wishes* are to encourage people to express their views e.g. on web pages, to study trends and research findings, to have creative meetings, etc. (Ottosson 2013).

The planning of want- and wish-based development is difficult and can only be done for short periods of time. Time-to-Market is dependent on how fast efficient and effective solutions are created. The demands on performance are the same or higher as for *need-based* development. In the early development stages creativity is utmost important and are other methods than CAE needed when known solutions cannot be used. Further, iteration backwards is needed when problems occur – when taken milestones are lost.
In accordance with table 1 both for want- and wish-based NPD, initially the development teams often have to take decisions based on very little and/or unreliable data. In turn that often results in reaching "dead ends" and frustrated teams that have to go back in what can be described as a PD labyrinth. In this situation the leadership is critical for if the project – of psychological reasons -will be successful or not after the new start.
As the most well-known product development models – such as Integrated Product Development (IPD), Simultaneous Engineering (SE), Concurrent Engineering (CE), and Stage-Gate® - all have stages that are separated by gates/decision points within which iterations can be done but not into earlier or later stages, this way of working does not work well for want- and wish-based development. Thus, as planning is only possible in short time spans (see table 1) more flexible/dynamic/agile methods are needed.

## Need, want, and wish development

When developing a new product from a need the circumstances are in general quite well-known which means a quick and rather simple development for which CAE in general can be used. The opposite is the case for want- and wish-based development. In practical development work many disappointments and re-takes are often needed before CAE can be used to finish the development. This in turn means a long development time to get a commercial product (a long Time to Market – TTM) (Björk 2010). Figure 2 shows this in principle. BAD-PAD-MAD in the figure stands for Brain, Pencil and Model Aided Design (Ottosson 2013).

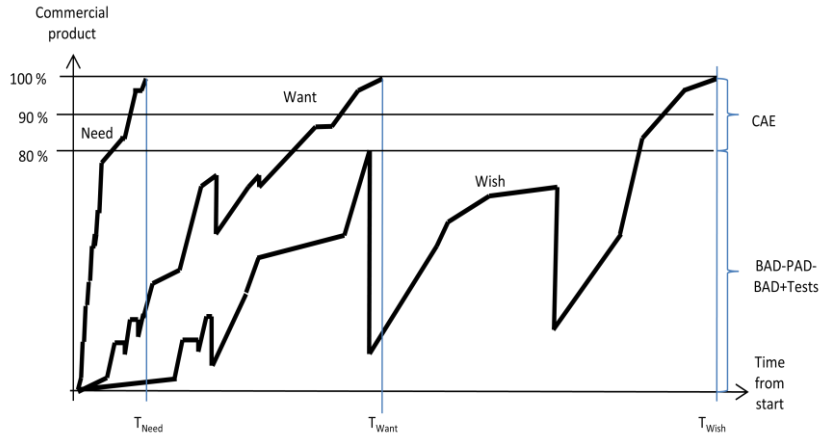


*Figure 2. The time from product development start of need-, want- and wish-based development to when a commercial product is ready depends on which start conditions there are*

When the start is a wish there are few if any solutions available to use. Thus Bench-marking often used to quickly get solutions when the development start is a need, is in general not a useful way to get started for want- and wish-based development. Also parametric design and reversed engineering in general is not usable. Instead the start must be to find a useful principle on an abstract and wholeness level and from there create and test solutions until a concrete solution on the detailed level is reached. For a want-based start some solutions exist to make the development easier and faster than for the wish-based situation. However also for a need-based PD project some considerations on the abstract/wholeness level is needed before the start of the development.
When the start is a wish or partly a want the principle called Dynamic Product Development - DPD can be used. It not possible to here explain this method to any degree as the most recent book on the dynamic theories and principles is on 320 pages (Ottosson 2013). [More about dynamic PD and want- and wish-based PD can be found in e.g. Björk 2003, Axeborn et al 2004, Ottosson 1998, 2003, 2004 &

2009]. However, Figure 3 shows steps to go to get a functional solution when the start is a wish or a want.

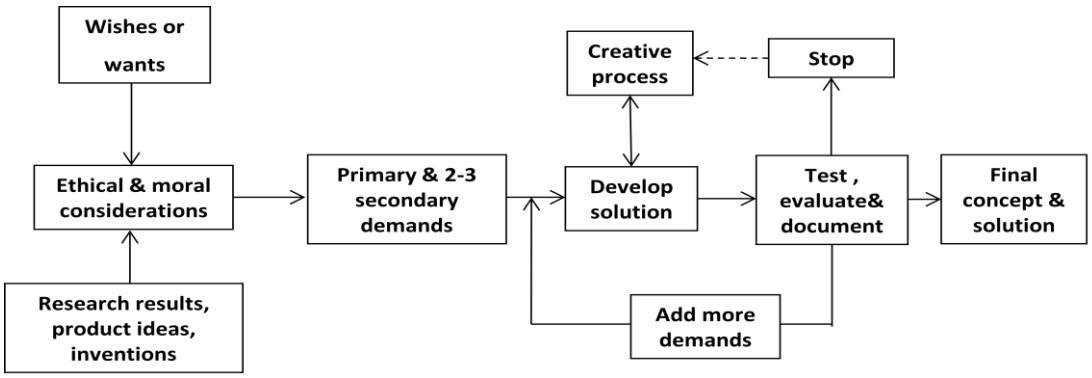


*Figure 3. The DPD™ concept generating process when the start is a wish or a want (Ottosson 2013)*

## Product values

Seen from the product developers' side, functional, sensorial/perceptory, image, emotional, and aesthetic values are the most important values to take care of when developing a universal product. Short about these values are (Ottosson 2013):

- *Functional values* are dependent on the technical solutions mostly hidden inside the product. The function can be simple as just filling out the space (e.g. the gas in a balloon or the concrete in walls). It can also be advanced with all degrees between simple and advanced – e.g. an engine in a car has simple as well as advanced parts and systems.
- *Sensorial/perceptory values* are based on what we experience with our five classic senses (see/hear/touch/smell/taste) from outside and/or in contact with a product. The product semantics is an important part of these values.
- *Image values* are based on the image we get of the product and what we think of it e.g. when closing our eyes. Brand names, patents, the image given on web pages, stories and the expressed experiences of the product by other users, etc., will influence and develop the image we have of the product. The product semantics can influence these values.
- *Emotional values* are the passion/feeling we have for a product. The product semantics can influence also these values.
- *Aesthetic values* are the experienced appreciation of art, beauty and taste.

## User-centered Design

Universal design is closely related to User-entered Design (UCD). A well functional order of different activities to make a user/use friendly solution is as figure 4 shows. The iterations shown in figure 3 are used for the practical work while the different DfX in figure 4 can be seen as checkpoints that one new solution is not harmful for another.

The first development efforts in figure 4 are Design for Usability (DfU), Design for Aesthetics (DfAe), Design for Ergonomy (DfEr), and DfSe (Design for Service) shortly described as:

- Design for Usability (DfU) generally is aimed at ordinary users meaning people with full capacity in different respects. Usability is the ease of use and learnability of human-made objects. Usability includes methods of measuring usability, such as needs analysis and the study of the principles behind an object's perceived efficiency or elegance.
- Design for Aesthetics (DfAe) - Industrial Design - focuses on design, appearance and the way people perceive products.
- DfEr (Design for Ergonomics) has the focus on the compability of objects and environments with the humans using them. The principles of ergonomic design is in general applied to "everyday" objects and work spaces.
- Design for Service (DfSe) has as aim that the product shall be easy, quick, reliable, environmentally friendly and cheap service on.

As the aim of the development of universal products is to make products that will work well for everybody, an extended User-centered Design strategy than of that described in literature must be used to fulfill that aim. Especially, describing all users that will use the product in the public environment is

not possible. Instead, finding user extremes and then to combine the solutions is a useful way (see Ottosson 2013) to get information to the following DfU and DfEr work. When that is done and solutions found, DfAe is done with the ambition that the products shall not "stick out". If the universal products break they must be easy to repair why much efforts also should be spend early on DfSe.

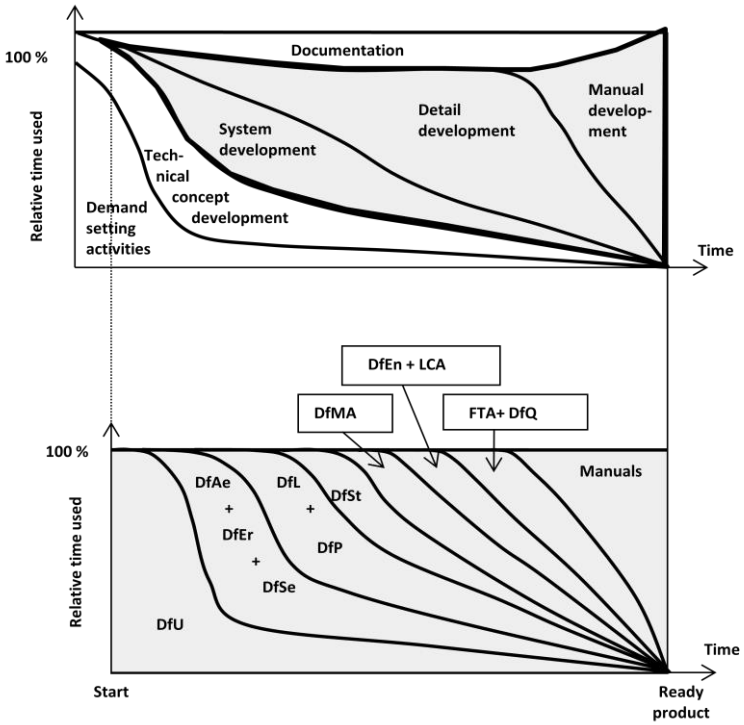


*Figure 4. New product development based User-centered design (Ottosson 2013)*

## NPD PROJECTS

According to common project definitions, a project shall be completed at a fixed finish time (T), at a predetermined performance (P) or quality (Q), and at a specified maximum accumulated cost (C) – the so called project triangle. For want- and wish-based development these three parameters unfortunately are rather meaningless to set other than for short time intervals. To follow up the development of a want- och wish-based PD project, however, two diagrams with P and C and with the same time axis can be used, which figure 5 shows an example of.

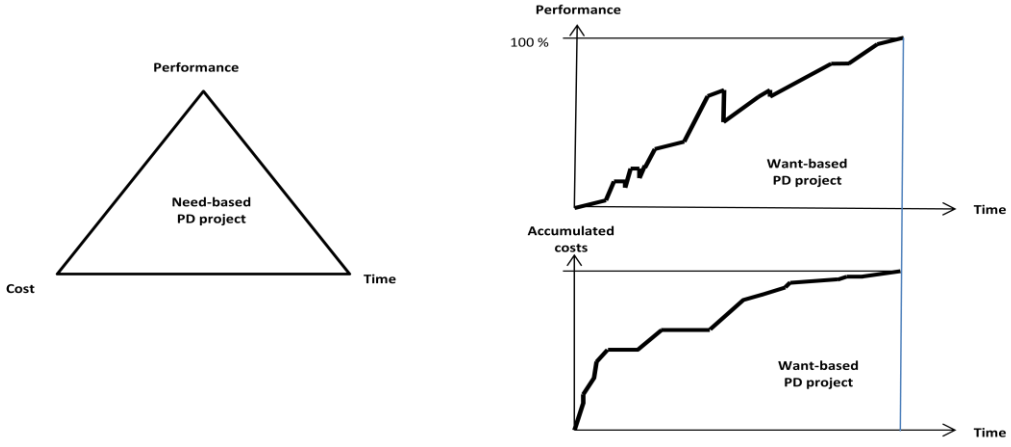


*Figure 5. The project triangle for need-based PD projects and the follow-up diagrams for a want-based PD project (Ottosson 2013)*

# 4 THREE EXAMPLES

To exemplify the differences between making wish-, want-, and need-based PD the development of three universal products will shortly be presented; a person lifting device for people with a weight

from 30 kg to 150 kg with different body shapes, a comfortable passenger body support system for small children to grown-ups, and a solution for warming up the stairs and the environment in a stair-way.

### The wish-based PD example

In the first case the development was based on a wish from nursing people to get a tool that was flexible, reliable, fast in use, and hygienic when lifting patients and disabled people e.g. from a wheel-chair to the toilet seat or from a wheel-chair to a bed, vice versa. This as the existing slings used were regarded having disadvantages in all these respects. Also a number of different slings were needed for the different use situations and body shapes of the people to be lifted meaning other disadvantages such as needed storing place, use of wrong slings, washing need, etc. The solution that was developed had the abstract idea parents' cautious lifting of a child face to face (see figure 6) instead of putting a sling behind and under the person before the lifting. Two occupational therapists were consulted during the work, that lasted one year equal to half a man-year for the development people (the project leader, consultants and the production people).

*Figure 6. Universal person lifting aid to be used instead of slings (the far right picture). To the left is shown the lifting of a disabled person from a wheel chair. The fourth picture shows a person being transported with a mobile lift from one place to another.*

The lifting tool worked well in the field tests done at hospitals, elderly homes, etc., and many advantages were gained with the new solution compared to the use of slings. E.g. with the sling solution it took in total 15-20 minutes for two nursing people to place a sling under the disabled person in figure 2 when he was laying in his bed, to lift him to his wheel-chair, to move him to the bath-room, to lift and lower him and to place him properly on the toilet chair, and finally to adjust the sling so he could make his toilet needs without affecting the sling in a non-hygienic way. With the new tool the same process took 5-10 minutes with only one nursing person. After the use the tool was cleaned with cleaning alcohol while the sling of hygienic reasons after only one or a few use situations had to be sent to the washing department. The short handling time meant less planning needs. A better hygienic situation was reached as well as less need of storing place. Etc.

However, the company that acquired the design and the patent got financial problems and went bankrupt. Only one small company has so far shown interest in taking up the production and marketing of the product again. This as the market situation is difficult – the hospital business is conservative and slings have been used for so long time in the market. Thus, a big disadvantage with the new solution is that the re-use of behavior is non-existent for the nursing people (Gourville 2006).

### The want-based PD example

In the second case there was a want from taxi drivers to get a positioning system for disabled passengers that should be stationary in the vehicles without causing dis-comfort for other passengers and that could function well for all types of disabled passengers. The solution was a four point principle belt system with different adjustment possibilities (see figure 7). The team leader was an occupational therapist who used hired people for taking care of development of the functional values. IPD was first tested as PD method but lead to a dead end that was dissolved when DPD™ was taken in as development method (Björk & Ottosson 2008).

The positioning belt system has got an expanding international market situation and can be regarded as a successful innovation.

*Figure 7. Universal positioning belt system for bodies of different size and constitutions (Björk & Ottosson 2008, www.careva.se)*

### The need-based PD example

In the third case there was a need to get the stairs in a stairway comfortable to walk on as they were cold to step on during cold periods of the year. This also created an unpleasant stairway climate and hardly a welcoming of guests and others in the house. The stairway (see figure 8) was de-mounted and the isolation taken away. Benchmarking was made on different systems to heat the stairs directly or indirectly. The solution was to first place a 1,5 dm isolation on top of a board, to seal it, to place an aluminum plate with a heating wire placed 1-2 dm under the stairs on top of the isolation and then to assemble the stairway again. The work including the finding of the proper – and unique - solution took 2 work days by two people.

*Figure 8. The different steps to make a cold stairway nice to walk in*

The solution resulted in a stairway that everybody can walk in without feeling dis-comfort. The solution that was implemented in December 2012 is not described in literature before and can possibly have a market for stairway builders.

## 5 CONCLUSIONS

All three products described (figures 6-8) can be seen as universal products well in accordance with the seven Universal Design principles.

Both the universal NPD projects based on a want and a wish (see figures 6 and 7) experienced a long and difficult development process in accordance with the principal figures 3 and 4. The bouncing between abstract-wholeness-concrete-detail was needed to at the end get commercial products. Only at the end of the processes CAE-tool were useful. Solution generations were done as figure 3 shows when new user body shapes and weights of the test people were tested. The principles shown in figure 4 were applicable in principle on the development of the two products although the shapes differed depending on the different nature of the products.

The classification in need-, want-, and wish-based development was meaningful in the described cases. For the NPD of the three universal products the guidelines of DPD have shown to be usable. To develop single products for everybody – which is the ambition with Universal Design - both technological and medical knowledge was needed. The problem bringing well functioning new products to also be innovations was demonstrated.

### REFERENCES

Axeborn, M., Gould, A. & Ottosson, S. (2004): *Dynamic product development of rain protection for vans*, Journal of Engineering Design, Vol. 15, No.3, pages 229-248

Björk, E. (2011): *Universal Design or modular based design solutions – a society concern,* ISBN: 979-953-307-196-0
Björk, E. & Ottosson, S. (2008): *Lessons learned from a want based NPD project,* International Design Conference – Design 2008, Dubrovnik - Croatia, May 19 - 22, 2008
Björk, E. Ottosson, S. and Thorsteinsdottir, S., E. (2007): *E-learning for all,* in *E-Learning: 21st Century and Challenges* (editors: Lipshitz, A.R. and Parsons, S.P.), Nova Science Publishers, Hauppauge NY, USA, ISBN: 978-1-60456-156-2 (pp 49-70)
Björk, E. & Ottosson, S. (2006): *Aspects of Consideration in Product Development Research, Journal of Engineering Design,* Vol 17, No 4
EU (2007): *Achieving full participation through universal design*, Committee of Ministers Resolution ResAP(2007)3
Gourville, J.T. (2006): 'Eager sellers and stony buyers', *Harvard Business Review,* June
Meerkamm, H. & Koch, M. (2005): *Design for X,* in Clarkson, J. & Eckert, C. (ed.): *Design process improvement: a review of current practice,* Springer Verlag, London, ISBN 1-85233-701-X
Ottosson, S. (2013): *Frontline Innovation Management,* Tervix, Göteborg, Sweden (ISBN 978-91-977947-7-0)
Ottosson, S. (2006): *Satisfying Needs, Wants and Wishes,* 6th IPD Workshop, Magdeburg
Ottosson, S., Björk, E., Holmdahl, L. and Vajna, S. (2006): *Research approaches on Product Development Processes,* Proceedings from Design 2006, Dubrovnic
Ottosson, S. (2004): *Dynamic Product Development - DPD*, Technovation - the International Journal of Technological Innovation and Entrepreneurship, Vol 24, (pp 179-186)
Ottosson, S. and Björk, E. (2004): *Research on Dynamic Systems – Some Considerations,* Technovation - the International Journal of Technological Innovation and Entrepreneurship, Volume 24, Issue 11 (pp 863-869)
Ottosson, S. (2003): *Participation Action Research – A Key to Improved Knowledge of Management,* Technovation - the International Journal of Technological Innovation and Entrepreneurship, Vol 23 (pp 87 – 94)
Ottosson, S. (2003): *Dynamic Product Development of a New Intranet Platform,* Technovation - the International Journal of Technological Innovation and Entrepreneurship, Vol 23 (pp 669-678)
Ottosson, S. (1999): *Planetary Organization,* Technovation - the International Journal of Technological Innovation and Entrepreneurship, Vol.19 (pp 81-86)
Ottosson, S. (1998): *Qualified Product Concept Design needs a Proper Combination of PAD-MAD before PDM,* Journal of Engineering Design, Vol. 9, No.2 (pp 107-119)
Randall, T, Terwiesch, C and Ulrich, K.T. (2007): *Research Note – User Design of Customized Products, Marketing Science,* March/April, Vol. 26, No. 2 (pp 268-280)
Stump, R.L., Athaide, G.A. and Joshi, A.W. (2003): *Managing seller-buyer new product development relationships for customized products: a contingency model based on transaction cost analysis and empirical test,* The Journal of Product Innovation Management, Vol 19, Issue 6 (pp 439-454)
Tseng, M.M. and Jiao, J. (2001): *Mass Customization* in: *Handbook of Industrial Engineering, Technology and Operation Management (3rd ed.),* Wiley, New York (ISBN 0-471-33057-4) (p 685)