Structural Change and Structural Policies
Edited by Prof. Wolfram Elsner
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Johanna E. M. Schönrok

Innovation at Large

Managing Multi-Organization, Multi-Team Projects

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Due to increasing complexity in new product development multi-organization, multi-team (MOMT) projects are becoming more common. They are formed in different industries like computer, automotive, aircraft, and space research. Since many of these projects still fail, more knowledge on the influences on performance in and of such projects is required in order to be able to manage them successfully. The author examines the influences of communication within and between teams on team and project performance, which in turn depends on applied design principles that structure and facilitate that information flow. Quantitative and qualitative analyses reveal that there are differential relations on the team and project level as well as for effectiveness and efficiency. Managerial implications are given of how to structure MOMT projects and the design problem-solving process and thereby facilitate the information flow within and between teams in order to make the teams and projects successful.

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Contents

List of Tables

List of Figures

List of Abbreviations

CV	Control Variable
DSM	Design Structure Matrix
IRR	Inter-Rater Reliability
MOMT	Multi-Organization, Multi-Team
NPD	New Product Development
PCA	Principal Component Analysis
VIF	Variance Inflation Factor

1 Introduction

1.1 Increasing Complexity in New Product Development

In new product development (NPD) the complexity of new products is continuously increasing (Hoegl and Weinkauf, 2005; McDonough et al., 2001; Wheelwright and Clark, 1992). This can be best illustrated by the history of high-tech products, whose successful development is the focus of this research.

Looking back a century, for instance, automobiles and aircrafts were much less complex than today. At the time of their invention these products were made of a small number of components that could be constructed by only a few individuals who had the necessary expertise and resources to complete the entire product (e.g., the 'Motorwagen' (motor vehicle) by Karl Benz in 1885, and the 'Stahlradwagen' (steel wheel automobile) by Gottlieb Daimler and Wilhelm Maybach in 1889; or the glider by Otto Lilienthal in 1891, and the first successful powered aircraft by the Wright Brothers in 1903) (Inventors, 2006; Aviation-history, 2006). Nowadays, even their many different functional parts (e.g., engine, electronic, and hydraulic systems) are so complex that they can no longer be developed by just a few individuals.

Complexity in NPD can be defined by three main elements: (1) the number of functional components/tasks, (2) the difficulty/newness of the tasks, and (3) the intensity of interdependence between the functional components/areas (Kim and Wilemon, 2003; Novak and Eppinger, 2001).

Complex new products are increasingly developed in very large NPD projects, comprising hundreds to thousands of persons in numerous teams. This collaborative team structure derives from the product's architecture (Sosa et al., 2004; Von Hippel, 1990). Each team is responsible for a certain (part of the) product's component(s). They are formed to integrate the various functional skills and expertise needed for performing the assigned complex design tasks (Hoegl and Gemuenden, 2001). This multi-team (MT) approach allows for highly specialized designing within teams with a certain degree of independence from other teams.

However, the diverse knowledge that is required often cannot be found within a single organization. The same applies to the different technologies and resources that are necessary. Because of the highly complex state-of-the-art technology, individuals and organizations are becoming more specialized (Bensaou and Venkatraman, 1995). This means different organizations need to collaborate in the NPD process leading to a multi-organization (MO) approach.

The development of complex new products, hence, requires diverse competencies and resources that often exceed the capacity of a single team (Hoegl et al., 2004) and strain even the largest firms (Kazanjian et al., 2000; Singh, 1997). Because of the increasing product complexity, multi-organization (MO), multi-team (MT) (i.e., MOMT) projects are becoming more common in NPD practice and will be increasingly encountered. As O'Sullivan (2003) states, they can be found in different fields developing products characterized by large scale, technological complexity and long duration. Advanced information- and communication technology supports this process (Dodgson, 1992; Premkumar et al., 2005) since for complex NPD the required dispersed expertise can be accessed and connected easily. Figure 1.1 gives examples of MOMT projects that have been established, mostly in recent years, to develop complex new products.

In this research MOMT projects are considered as being complex themselves since numerous members of diverse functions from different organizations, also located in different countries, cooperate in many teams to jointly develop a complex new product. In collaborative work they can profit from the synergetic effects of the combination of expertise and resources (Harvey and Koubek, 2000; Mintzberg et al., 1996; Saavedra et al., 1993; Singh, 1997) and can reduce high costs and risks in order to be more competitive (Dodgson, 1992).

However, MOMT projects are very challenging. To deliver insight into the challenges of these projects, an example of the ***aircraft industry***, namely the development of the Airbus A380 – with 555 seats on two decks the world-biggest and most complex passenger jet ever built, is given in more detail.[1] In December 2000, Airbus (daughter of EADS) voted to build the A3XX, renamed as the A380 with estimated costs of about 10bn euros. The prime contractors are France, Germany, UK, and Spain; and the industrial partners are Australia, Austria, Belgium, Finland, Italy, Japan, South Korea, Malaysia, The Netherlands, Sweden, Switzerland, and USA (Airliners, 2006). In France, within many different teams, the center wing box, center fuselage, nose section and radome are developed. In Germany the aft and forward fuselage and vertical tail plane, in Spain the tail planes and central belly fairing, and in the UK the wings are developed. All parts are assembled in Toulouse, France. (BBC Southern Counties, 2004)

During the development of the super-jumbo there were several delays, for instance, due to massive wiring problems (BBC business, 2006; Parker, 2006). Each plane needs 500 kilometers of wiring in the sections of the fuselage. Because of a lack of communication – not recognizing the relevance of decisions

[1] Please note: if not indicated differently, the case description is based on BBC business news (http://news.bbc.co.uk/1/hi/business). More precise addresses accessed from this website are provided in the reference list.

Computer technology: e.g., Fujitsu Limited (Japan) and Siemens AG (Germany) founded Fujitsu Siemens Computers (Holding) B.V. in October 1999 to 'synergize innovative drive and strengths', working in different specialized teams like information technology and information system, customer support, services, and marketing (Fujitsu-Siemens, 2006). However, there is still a high market uncertainty not only because of competition, like Hewlett-Packard's takeover of Compaq in 2001, but also because of falling computer demands (BBC Business, 2001).

Automotive industry: e.g., the BMW Group, DaimlerChrysler (both Germany), and General Motors (USA) jointly develop a two-mode hybrid drive system they each want to apply in their individual vehicles. In September 2005 they signed a "memorandum of understanding" to 'pool the development expertise' and 'integrate best technologies on the market', working in highly specialized teams on the design and development of the different parts of the hybrid drive system (General Motors, 2006). They planned to unveil the hybrid drive system the end of 2007, with a cost of $1 billion. Competitor Toyota has already successfully introduced the hybrid in 1997 and improved further since then (Weber, 2006).

Public transport infrastructure: e.g., the Channel Tunnel that connects France and the UK was a joint construction of both countries that had started in 1988. The Channel Tunnel officially opened in 1994. Construction problems arose because the construction teams were working virtually independently on each side of the channel. There was a construction cost overrun of fixed prices of 80 percent (Flyvbjerg et al., 2003). Besides the exceeded construction costs there was also a delayed operation and the ticket sales of the train service were disappointing (Grün, 2004).

Energy transport infrastructure: e.g., the Baku-Tblisi-Ceyhan (BTC) pipeline from Azerbaijan via Georgia to Turkey – the second longest oil pipeline in the world – was commissioned by a consortium of energy companies led by BP (UK), with the members AzBTC (Azerbaijan), Chevron (USA), Statoil (Norway), TPAO (Turkey), Eni (Italy), Total (France), Itochu (Japan), INPEX (Japan), ConocoPhillips (USA), and Amerada Hess (USA). Different teams for, for instance, consultation, land acquisition and community, and construction, collaborated. The construction began in September 2002, and the pipeline was officially inaugurated on July 13, 2006; more than one year behind schedule (Chossudovsky, 2006). The construction costs were 30 percent above the original estimate ($3.9bn instead of $2.95bn) (Alexander's Gas and Oil Connection, 2006).

Cooperation in non-profit sector: e.g., the European alliance for motorists 'ARC Transistance', founded in 1991, is a cooperation of the 8 major European automobile clubs (i.e., AA UK, ACI Italy, ADAC Germany, ANWB The Netherlands, ÖAMTC Austria, TCB Belgium, TCS Switzerland, and RACE Spain) (ARC Transistance, 2007). The process innovation – providing mobility related services to the motoring industry and transnational membership assistance services – is challenging as different teams and countries with different cultural backgrounds, systems and methods are cooperating.

Grand sporting events: e.g., Olympic Games are a set of different sub-projects that include the facilities for competitions and housing of the athletics, provided by different organizations and teams. As Grün (2004) has shown in different case studies on Summer and Winter Games, there are often high cost overruns (e.g., Winter Olympics 1994 in Lillehammer had a deficit of $700m) and remarkable reductions in quality like collapsing transportation systems (e.g., Olympic Winter Games 1980 in Lake Placid).

Space-research technology: e.g., the International Space Station ISS: National Aeronautics and Space Administration NASA, Russian Federal Space Agency, European Space Agency ESA, Japan Aerospace Exploration Agency JAXA, and Canadian Space Agency CSA have signed the 'International Space Station Intergovernmental Agreement' (IGA) in January 1998. It is a cooperative program for the joint development, operation and utilization of a permanently inhibited Space Station in the low Earth orbit (ESA, 2006). This involvement of many different teams and nations can be problematic. For instance, in April 2001 a computer failure led to a major disagreement over which nation should deliver what part for the station (BBC science, 2001).

Figure 1.1 Examples of MOMT projects in different fields