

Teaching the NPD Lifecycle to Engineering Students

Abstract

Engineering students typically receive little exposure to marketing concepts or tools in their undergraduate coursework. They may not effectively integrate marketing activities with engineering tasks when they become involved in new product development (NPD) during their careers. A simulation was developed and used in our Marketing and Entrepreneurship courses in which participants start with a product idea and traverse the development cycle to product launch. They make decisions allocating time and money as they: search for customers, gather customer data using interviews, trade shows and focus groups, define market segments, select & build product features, set their price, and allocate funds to promotion at launch. They receive feedback at launch and then undertake a second development cycle to improve their scores. Preliminary testing has measured student learning and students enjoy the simulation.

An effective simulation design allows it to be used in a single session of 2 to 3 hours. The design includes advisors who suggest approaches and offer guidance throughout the development cycle. The software tracks participant choices and progress. The accumulated experience of completing simulated tasks, together with the interpretations and suggestions offered by advisors, allows participants to learn NPD best practice, the early integration of marketing into the development cycle. This overcomes the commonly observed practice of insufficient marketing and business analysis in early stages of NPD (e.g., Cooper 2001). The conference presentation will include a demonstration of the simulation interface.

Introduction

An effective communication approach is to begin by presenting an overview, an Organizing Principle, to an audience, then as additional information is presented it can be linked back to the Organizing Principle. This supports the audience in developing a holistic framework of the subject. A table of contents can provide this learning aid, though often these structures are dominated by sequence of presentation. An Organizing Principle should be more thematic and support the additional information by offering a core structure to which additions are easily linked.

Teaching marketing to engineering students presented the challenge of helping them see 'the forest and the trees'. Textbooks and journal articles addressed components of marketing, e.g., segmentation, pricing, collecting customer data, etc. Various models, such as Cooper's StageGate¹, offer a process overview but it seemed students did not develop a unified understanding that would allow them to adapt NPD strategies to changes in development context. At a more detailed level, student understanding of some component tasks, specifically customer segmentation, was superficial.

Proponents of experiential learning have offered theoretical frameworks, and evidence, that active learning environments promote deep understanding². Observers of trends in higher education argue that greater use of simulations and other forms of experiential learning is a necessary change³. Senge⁴ has discussed the concept of 'MicroWorlds', or 'Management Flight

Simulators', as the key technology in his 'Learning Organizations'. He offers evidence from his consulting experience using simulations on their effectiveness in supporting participants' development of mental models to better understand the managerial issues they face. Obviously the claim of a causal link that 'simulations cause learning' is very simplistic as there is tremendous variation in simulation design and relatively little evidence exists to support claims for superior the pedagogical impact of any particular design. The literature addressing simulation design for effective pedagogy was reviewed and recommendations were blended to develop a management simulation for teaching best practice in New Product Development.

A simulation to teach best practice in NPD

Players begin with an idea for a product and develop it to product launch, a cycle that may take 10 to 20 simulated months. This is compressed into 60 to 90 minutes of playing time. The simulation design allows experiencing the entire lifecycle in a single, uninterrupted session, and this supports players in developing an integrated, holistic understanding of the NPD process. In Version 1, players adopt a role of an entrepreneur who starts with a fixed financial resource and works alone to launch the product before expenses exhaust it.

The primary issue players face is selection of features to include in the product. The secondary issues they must address in defining their product include, How much time to spend contacting customers, Which potential customers to contact, What customer data to use in selection of product features, When to use trade shows or focus groups to gather information, Defining customer segments, and Setting the price of their product. After the product is launched, participants receive feedback on market success. Success is largely determined by the match between the features included in their product and those the various market segments want.

Because customer needs and segments are initially unknown, (randomly drawn at the start of each game) participants must discover these through their actions: customer interviews, trade show attendance, focus groups, talking with their advisors, and the search of media sources. At an abstract level, player activities can be seen as several search processes. Players search for: product features, customers, individual customers needs, customer segments, technical information (needed to complete engineering tasks), solutions to technical development problems, optimal product price, and optimal promotional launch spending.

One simulation feature that helps participants migrate through the many decisions is the inclusion of advisors. In each game participants interact with an advisor who offers suggestions, hints, and interpretations of simulation events. Another feature is the 'paired-game' design in which participants complete one game (from idea to product launch), receive feedback from the model and advisor comments, then undertake a second (the 'paired') game. The second game allows practice of lessons learned in the first game. Also, participants insights are supported because they can view a sequential record of their performance in the first game and use this to improve their strategy.

Cooper¹ has documented that insufficient marketing is a common NPD problem as. Engineers in particular often over emphasize technical aspects of NPD projects - which can be very challenging - and under emphasize marketing. Market Orientation is the central concept of Marketing (Gebhardt 2006). Understanding customer needs and developing means to meet those

needs is the *raison d'être* of a firm with a Market Orientation. This however is not the primary orientation of our engineering students, many of whom were raised on Dilbert cartoons and have a rather dim view of marketing.

We have seen specific examples of behaviors in our students and in clients in our incubator in which they avoided marketing activities during NPD. We speculated why these behavioral patterns persisted and concluded that the insufficient effort in marketing activities is driven by attitudes and beliefs, not simply a lack of information about the need for marketing, or an understanding of marketing technique. We conclude that training to improve the NPD approach must address deeper learning for these entrepreneurs, something that causes a rethinking of their mental models and produces change in a system of beliefs and attitudes, their mental models.

For example, one set of beliefs concerned entrepreneurs' understanding of the time required to adequately conduct marketing. Some entrepreneurs believe that a good product will sell itself, that customers will find them. These beliefs support the practice of putting little effort into marketing, and postponing that effort until after product development is substantially complete. Entrepreneurs who build technical products often expect that the marketing activities will require substantially less time than the technical tasks associated with designing and building the product. The simulation provides a record of the amount of time spent on technical tasks and marketing tasks. Because a significant effort is required in the simulation to complete marketing tasks, it becomes obvious to participants that marketing may indeed require a substantial time investment. Further, moving that effort forward to early development has benefit in the simulation, as the literature claims it should.

Several beliefs about potential customers also seemed to support the behavior of insufficient or late marketing effort. One issue is a reluctance to reveal their ideas. For some, there is concern that others may copy or reveal their ideas to others. For some, they feel their ideas (or product) are not yet fully enough developed. They want to improve (we sometimes thought 'perfect') the product before showing it to customers. This could have a base in a fear of rejection of the ideas. The simulation message presents an alternate set of beliefs, that talking to customers early – even with unpolished ideas or incomplete products – allows for faster, more efficient NPD development. The simulation advisor suggests early identification & selection of customer segments makes the success of the launch more likely.

A related issue is that entrepreneurs often believe that the cost of marketing will be small relative to the cost of engineering. This leads to a practice of under-pricing their product. They will, for example, make an estimate of the cost of building the product and then set the price as a mark-up percentage (e.g., 15%) higher than the forecast cost. Our experience is that marketing and related non-engineering costs are at least equal to, often greater than the engineering & initial production cost. We have seen start-up companies struggle with cash flow because their low price produced small margins. The simulation choices include setting the product price and that choice is framed in view of an estimate of engineering and marketing costs. The simulation message is that marketing is time consuming, and can cost more than product engineering & development.

A final issue mentioned here is segmentation. The technical entrepreneurs we observed had little understanding of segmenting customers. When faced with an initial low sales volume a common

response was, 'Sales will increase after we add the next feature'. Note that this is again a technical approach to the low sales problem, one that completely obfuscates a marketing approach, such as research on How customers perceive the existing product or What features they want.

An interesting observation from early testing of the simulation was that students universally focus on customers who will pay a high price. That becomes their definition of the target segment, regardless of whether those customers share interests in other product attributes. A more complex assessment would include an assessment of segment size (potential sales volume) as well as the cost of developing the product that each segment wants. This has never been the initial approach used by students, and raising their understanding to this level has been added as a learning objective as we have continued to revise the simulation. The simulation choices include assigning customers to segments and participants receive feedback at product launch on how well they targeted customer segments. The simulation message is that a more robust comparison of segments, and selection of targeted segments based on key attributes (size, return, reach-ability, growth, etc.) is more likely to produce a successful launch.

In summary, the NPD simulation message is consistent with published best practice in NPD. It contributes an interactive environment that supports participants in learning new mental maps of the NPD terrain. This learning environment is an integrated system providing interpretations and feedback that guide participants in exploring that terrain and how published 'best practice' can be melded into NPD strategies.

Early simulation use and evaluation

The NPD simulation had been used in more than a dozen classroom sessions in five colleges. A quantitative assessment was conducted using a 17-item questionnaire completed before and after 94 students participated in a series of classroom exercises. Significant attitude change was measured in this 2008 trial and is reported elsewhere. The simulation has been further developed based on student feedback from these sessions.

Figure 1 shows simulation results at the end of a class exercise. Participants spent more time (non-task time) to collect more customer data in game 2. They also undertook activities to build their credibility with customers thereby making their customer data collection more effective. Changing their NPD strategy resulted in much higher revenues in game 2 and they understood how their pattern of behaviors caused this result. The adoption of different strategies in the two games, and the improved outcome in game 2, demonstrate that participants adopted different approaches in the games and that they adopted an approach closer to that judged 'best practice' in the literature in game 2.

	Game 1	Game 2
Launch Month	9	12
Task Time	602	768
Non-Task Time	118	192
Features Built	5	6
Technical Data	35	37
Marketing Data	25	145
Customer Visits	14	16
Customer Details	19	31
Segments	3	4
Credibility	53	196
Price	\$ 294	\$ 325
Total Revenues	177	552

Exhibit 1. Example feedback at simulation end.

Future simulation development

The original simulation was built for single-players in which individuals take the role of an entrepreneur and independently interact with the simulated environment. A business school expressed interest in using the NPD simulation as a research tool for team decision making after seeing a demonstration. They asked that the simulation be enhanced to support a multiplayer version. A chat function was developed allowing team members playing on different computers to exchange text messages. Additional coding shares the status of team members (e.g., tasks accomplished, information found, customers contacted) via a web server. We intend to conduct trials to assess the impact of these changes on the simulation's pedagogical efficacy in 2011.

Bibliography

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