Cultivating technology commercialization teams

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To achieve commercial success, various factors must be satisfied beyond the mere technical viability of the technology.

During the past decade, publicly funded organizations have been under increasing pressure to generate revenues as a means of offsetting decreases in government funding. For some universities and government laboratories, this has meant a redressing of technology transfer, with a change of emphasis from broad dissemination of knowledge (e.g., through technical journals and scientific conferences) to meeting commercial objectives.

Publicly funded laboratories (labs) transfer technology for commercial purposes in at least three primary ways. These processes should not be regarded as being mutually exclusive.

- In collaborative Research and Development (R&D), a lab works jointly with a company to address a technological problem leading to some product or process.

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improvement. The company reimburses the lab for all or a portion of the cost of developing the technological improvement. The lab transfers the technology through the collaboration and typically concludes the transaction with an industrial confidential technical report outlining the technological improvement.

- **In technology licensing**, a lab develops a new technology and transfers it to a company through a licensing agreement. The commercialization of the technology by the company leads to a new product or process. A licensing fee or royalty is typically paid by the company as a way of reimbursing the lab for the costs of developing the technology. Lab personnel are often encouraged to participate in the commercialization of the technology as part of the technology transfer process.

- **In technology spin-off**, a new start-up company is formed to commercialize a technology developed by the lab. It is often desirable to involve lab personnel in the formation and operation of the new start-up company to improve the probability of success. Some organizations, such as the National Research Council, in fact have programs to encourage the creation of spin-off companies. In these situations, the technology transfer process may be facilitated through the provision of incubation space to the company, as well as access to lab personnel, equipment and facilities.

The technology transfer process in each of these cases differs significantly and requires a different set of skills and tools. There is a general misconception that if a technology is good enough, it will “sell” itself. In fact, for commercial success to be achieved, various factors must be satisfied beyond the mere technical viability of the technology.

Factors contributing to the successful commercialization of a technology are complex. For example, from the lab perspective, they include the need for appropriate practices and programs to support the technology transfer and commercialization process such as project portfolio selection techniques, organizational structures, technology evaluation techniques, reward systems and project management tools, to name but a few. For commercial success to be achieved, the receptor company must also meet certain stringent criteria, including having a well-defined business plan, an appropriate management team and access to financial resources.

At the root of a successful technology transfer and commercialization process is the need for an effective team, comprising both lab and industrial personnel, working together to oversee the transition of the technology from the lab to the marketplace. To contribute to our understanding of this team building process, we examined several case studies involving technology transfer from government labs to industry. In this study, we defined “success” on the basis of how well the project attained the industrial partner’s profit objectives.

### Project methodology

The conceptual framework for this study was the Theory of Cascading Commitment. We derived this theory from an extensive review of the technology transfer literature. At its core, the theory consists of seven overarching propositions, as outlined in Exhibit 1.

All participating labs were asked to submit lists of commercialization projects that met the following requirements:

- the project involved primarily a tangible product or process, not software;
- the project was discrete, not part of a longitudinal series of projects;
- the lab was deeply involved in the development of the technology, not simply funding it;
- the project outcome was known and relatively recent; i.e., the project was not still in development, and its commercial success or failure had been established within the previous three years.

Initially, 67 projects were nominated by representatives from seven federal government labs. The list of projects did not represent a random sample of all the labs’ projects. Indeed, it was more of a convenience sample, where projects were selected based on their ability to meet the list of qualifications, and the lab representative’s expectation that the project’s key contact would be available and willing to participate in the study. Thus, no conclusions can be drawn regarding the labs’ overall statistical success rates.
Assuming that the contact coordinates of at least one linchpin could be supplied by the lab for each project, a “retrospective snowball survey” was specified as an appropriate empirical methodology. We developed a questionnaire in several stages, including reviews by the lab representatives and a pre-test by three government scientists from projects which were not used in the later study. We customized the questionnaire to some extent for each type of linchpin to reflect the linchpins’ different sets of perceived motivators.

Of the 67 projects originally identified and pursued, 34 projects generated at least one usable questionnaire and were retained for the analysis. The names of the 34 technologies, their associated labs and their success ratings are shown in Exhibit 2 (see page 20).

For the 34 usable projects, 140 linchpins were ultimately contacted, to which 80 consenting individuals were sent questionnaires, and from whom 63 usable questionnaires were returned. Thus, on average, just over four linchpins were solicited per project and just under two questionnaires were received.

Of the 63 usable questionnaires received, 17 were from government managers, 18 were from government scientists and 15 were from company managers. This relatively high response rate from those roles probably reflects a high personal incentive to participate in this study, based on a high personal stake in the improvement of technology commercialization processes.

Support for the theory of cascading commitment

A detailed statistical analysis of the results obtained from this study is reported separately.

In general, the quantitative results tended to confirm the Theory of Cascading Commitment. The essential results were as follows:

- Proposition 1: A complete team of diverse players is necessary.
  - The average number of organizations on successful teams was significantly larger than on unsuccessful teams.
- Proposition 2: A complete team of linchpins from both public and private organizations is necessary.
  - The average number of linchpins on successful teams was significantly larger than on unsuccessful teams.
- Proposition 3: There is an optimal sequence for recruiting the organizational partners.
  - There was sufficient evidence to suggest that the earlier the test customer (i.e., end-user of the technology)
is recruited, the better; the earlier the manufacturer is recruited, the better; and recruiting the test customer before the manufacturer is better.

- Proposition 4: There is an optimal stage for recruiting each organizational partner.

Results tended to indicate that the earlier the stage of government/industry contact, the better; the earlier the stage of test customer recruitment, the better; and the earlier the stage of manufacturer recruitment, the better.

- Proposition 5: There is a need for total commitment.

There were generally equal and high levels of commitment for the linchpins in unsuccessful and successful projects. Hence, commitment is necessary but not one of the key discriminators between success and failure.

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<td>Red clover cultivar</td>
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Degree of success in achieving commercial success and meeting profit objective:

1 – very unsuccessful
2, 3 – unsuccessful
4 – neither successful nor unsuccessful
5, 6 – successful
7 – very successful
Proposition 6: There are diverse determinants of a linchpin’s commitment.

There was significant support for the proposition that linchpins are motivated by a variety of factors drawn from a diversified set of perceived incentives and rewards, and the credibility of the team’s prior organizations and/or linchpins. The most important motivators appear to be the linchpins’ perceived technical and financial benefits for the end customer. Monetary rewards did not appear to be a prime motivator for lab scientists.

Proposition 7: Commitment is necessary until launch.

There was some support for the proposition that the complete team of linchpins should stay intact until launch. However, the statistical evidence for this proposition was weak due to limitations in the data.

The additional qualitative commentary provided by the respondents confirmed the importance of very carefully selecting the right individuals from the right companies to maximize the probability of success. In view of the evidence, and in spite of the small sample size employed in this study, we concluded that the Theory of Cascading Commitment has been substantially supported.

Technology push vs. technology pull

One issue that was not specifically addressed in the original presentation of the Theory of Cascading Commitment was the effect of a project’s origin; i.e., was the project being “pushed” by the government lab or was it being “pulled” by the company?

In the original theory, we assumed that all of the projects originated in the government lab, but in the course of defining the case studies, we realized that many projects either originated in the private sector or were developed jointly. Thus, we gathered data to investigate the “push” versus “pull” effect.

Again, the statistical analysis for this part of the study is detailed elsewhere. There was strong evidence to suggest that industry- or jointly-conceived technologies (technology-pull projects) seem to have a better chance of success than government-conceived technologies (technology-push projects). However, this does not imply that no government-conceived projects should be pursued.

Likewise, while government-initiated projects can succeed, industry-initiated projects seemed to have a better chance of success. Again, this does not imply that no government-initiated projects should be pursued.

Additional comments from respondents

Respondents were given space in the questionnaires to provide qualitative comments on any issue pertaining to technology commercialization. Also, many individuals who did not complete a questionnaire felt motivated to submit supplementary commentary. Our examination of the qualitative commentary showed that the comments could be grouped under the following four general observations:

Commercialization infrastructure – Many individuals felt that the lab should be better prepared in terms of education and training with respect to the technology transfer and commercialization process. Many offered suggestions as to how the lab can facilitate projects, especially with more technical, financial and person-year support, less bureaucracy and more decentralized decision making. Two also commented on the necessity of a government pool of seed money to help with commercial projects. Much time can be wasted, and competitive advantage therefore lost, if a champion has to convince third-party financiers of the commercial potential of a new technology. Establishing a “risk-money” pool of capital to help prototype development, market research and advertising might be considered as a mechanism to substantially improve the labs’ results in high involvement commercial projects.

Project team selection – Collectively, the respondents’ comments emphasized the notion that potential partners need to be rigourously pre-qualified. In particular, the potential partners need top credentials and similar objectives. The need for dedicated champions, both managerial and technical, was also highlighted. These comments reinforce the propositions of the Theory of Cascading Commitment that pertain to the need for
many organizations and many champions on the team but only those which have the necessary credentials and commitment. They are also entirely consistent with private sector practice to form complete and dedicated cross-functional teams.

- Project implementation process – Several respondents' comments emphasized the ideas of early and close contact among all the members of the team, especially early contact with the end customer of the technology. Thus, beyond assembling the right team, the project manager should strive to optimize the execution of a high involvement project. The need for project speed and the need for the team to endure until commercial launch were also highlighted. These observations go beyond the scope of the Theory of Cascading Commitment but are entirely consistent with current “fast-cycle” practices in the private sector. To accomplish speed, techniques such as concurrent engineering and stage-gate project execution are ubiquitously employed.

- Intellectual property – There is a general perception that the private sector has difficulties in negotiating intellectual property (IP) rights with the government. And yet, of the 34 case studies we examined, IP rights were raised as being a problem in only one of the cases. Technology transfer and commercialization are governed by many complex factors; but IP rights were not raised as being a determining factor in the success or failure of a project. The orderly transfer of IP can be accomplished through a licensing agreement that outlines the rights and obligations of each party. There was no evidence to suggest that companies interested in commercializing government-developed technologies wished to own the IP, provided they were given the right to exploit the IP.

### Lessons learned

The results of this study suggest that the following would be a good starting list of best team-building practices to consider for lab managers:

- in selecting the commercial project portfolio, and all other factors being equal, place more emphasis on projects with industry- or jointly-conceived technology; clearly, this does not imply that lab conceived technologies should be eliminated from the portfolio;

- for each project, recognize that a complete team of linchpins will be necessary, and allocate the necessary time and financial support for the project manager to identify and recruit the linchpins;

- advise the project managers to recruit a credible test customer and manufacturer as early as possible in the development cycle, recruiting the test customer before recruiting the manufacturer; if a test customer cannot be recruited, it may indicate a lack of market interest and suggest the need to cancel the project;

- establish a specific pool of seed/risk money to enable the project manager to conduct initial commercial feasibility studies, identify credible test customers and fabricate alpha prototypes to help attract test customers;

- consider the implementation of fast-cycle and stage-gate project management techniques currently employed in the private sector; and

- do not rely solely on monetary rewards for the lab scientists.

### Endnotes


