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ESSAYS

PAPER 1

Die Rolle von Geschäftsmodellen im Gründungsprozess – Eine Systematische Literaturanalyse

Franziska Günzel & Juliane Krause

Abstract

Bis heute besteht weitgehende Unklarheit darüber, was ein Geschäftsmodell ist und welche Bedeutung es im Unternehmensgründungsprozess hat. Im folgenden Beitrag wird anhand einer systematischen Literaturanalyse ein Überblick über bisherige Forschungsergebnisse und über den zukünftigen Forschungsbedarf zu Geschäftsmodellen gegeben. Im Hinblick auf die Ergebnisse der Literaturanalyse wird ein konzeptionelles Modell als Handlungsgrundlage für Gründer und Gründungsausbilder vorgestellt, um das Geschäftsmodellkonzept in Zukunft effektiver einzusetzen.

Stichworte: Geschäftsmodelle, Systematische Literaturanalyse, Entrepreneurship, Gründungsprozess, Innovation, Strategie

Note: This paper has been accepted for publication at the journal Betriebswirtschaftliche Forschung und Praxis. The formating of the references has been capted in line with the journals instructions.

1. EINLEITUNG

Immer häufiger werden Gründer von Investoren gebeten, ihr Geschäftsmodell zu erläutern.[1] Während es für Gründer üblich ist, Businesspläne zu erstellen, sind sich viele unsicher, was sie präsentieren sollen, wenn sie nach ihrem Geschäftsmodell gefragt werden.[2] Obwohl der Begriff Geschäftsmodell bereits 1957 zum ersten Mal in einem wissenschaftlichen Artikel erschien und seit der Expansion der Internetfirmen zu einem beliebten Schlagwort in den öffentlichen Medien wurde, bestehen noch immer viele Unklarheiten in Bezug darauf, was ein Geschäftsmodell wirklich ist und wozu es dient.[3] Folglich existieren zahlreiche unbeantwortete Fragen, wie z.B.: „Welche Komponenten zählen zu den Bestandteilen eines Geschäftsmodells?“ und „Wie sollten Geschäftsmodelle in der Praxis und Lehre angewandt werden?“. Dies führt dazu, dass der Begriff Geschäftsmodell willkürlich und irrtümlich in Forschung und Praxis verwendet wird.[4]

Vermehrt sind Geschäftsmodellansätze nun auch in der Entrepreneurship-Literatur zu finden.[5] Es wird argumentiert, dass es unerlässlich ist, im Unternehmensgründungsprozess so zeitig wie möglich ein Geschäftsmodell zu definieren, denn es stellt das zentrale Gebilde dar, welches die Vorgänge einer Existenzgründung koordiniert und den Gründer in die Lage versetzt, mit Komplexität sowie Unsicherheiten umzugehen.[6] Jedoch haben die Vielfältigkeit und Unübersichtlichkeit der Geschäftsmodellliteratur dazu geführt, dass eine einheitliche Definition und eine allgemein anerkannte Betrachtungsweise fehlen. Daraus resultierende fragmentarische Ansätze sowie an Vergleichbarkeit mangelnde Ergebnisse führen wiederum zu einer erheblichen Unklarheit unter Entrepreneurship-Forschern, Ausbildern und Praktikern über das Konzept selbst sowie dessen Wert und Platz im Unternehmensgründungsprozess.[7] Diese Erkenntnisse spiegeln sich auch in der

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[1] Vgl. Morris/Schindehutte/Allen (2005).
[2] Vgl. Shafer/Smith/Linder (2005).
[3] Vgl. Porter (2001); Knyphausen-Aufseß/Meinhardt (2002); Magretta (2002).
[4] Vgl. *Magretta* (2002).
[5] Vgl. Morris/Schindehutte/Allen (2005); George/Bock (2009).
[6] Vgl. *Sandberg* (2002).
[7] Vgl. Osterwalder/Pigneur/Tucci (2005); Doganova/Eyquem-Renault (2009);

Gründungsbegleitungserfahrung der Autoren wider. In den letzten fünf Jahren haben wir zahlreiche Hochschulausbildungsprojekte begleitet, das Geschäftsmodelldesign und die Geschäftsmodellweiterentwicklung betreut und sind dabei immer wieder mit der uneinheitlichen Betrachtungsweise in Konflikt geraten.

Um dieser Problematik zu begegnen, wird in dieser Arbeit eine Übersicht und Synthese der bestehenden Geschäftsmodellliteratur gegeben. Dies soll Wissenschaftler detailliert über bisherige Forschungsergebnisse informieren und Lücken identifizieren, wo weitere Forschung benötigt wird. Die aufgezeigten Ergebnisse der Literaturanalyse erlauben zudem eine Einordnung des Geschäftsmodells in den Gründungskontext, was Gründern sowie Entrepreneurship-Ausbildern als Grundlage für die Anwendung dienen soll.

2. SYSTEMATISCHE LITERATURANALYSE

Für diese Studie wurde die Methode der systematischen Literaturanalyse (SLA) ausgewählt. Die SLA wurde in den 1990er Jahren in Großbritannien, insbesondere im Bereich der Medizin, entwickelt.[8] Seitdem wurde dieses Verfahren zur systematischen Sammlung und Aufbereitung bereits existierender Studien auf mehrere Forschungsbereiche, wie die Wirtschafts- und Sozialwissenschaften, übertragen.[9] Die große Stärke der SLA gegenüber der narrativen Literatursichtung liegt darin, dass mit ihrer Hilfe umfassende Literaturuntersuchungen durchgeführt werden, welche transparent und damit offen für Überprüfungen und Wiederholungen sind. Überdies lassen sich mittels der SLA die Suchergebnisse verschiedener Forschungsbereiche mit ihren unterschiedlichen Methoden gegenüberstellen und verbinden.[10] Aufgrund der Verwendung systematisch ermittelter Suchwörter und der Suche in mindestens drei verschiedenen Datenbanken kann ein breites Feld an Veröffentlichungen abgedeckt werden.[11] Jede Veröffentlichung wird auf ihren eigenen Beitrag hin untersucht, wobei durch eine induktive, iterative Vorgehens-

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George/Bock (2009).
[8] Vgl. Tranfield/Denyer/Smart (2003).
[9] Vgl. Tranfield/Denyer/Smart (2003); Denyer/Neely (2004).
[10] Vgl. Tranfield/Denyer/Smart (2003); Denyer/Neely (2004).
[11] Vgl. *Pittaway et al.* (2004).

weise Verzerrungen seitens des Betrachters vermieden werden.[12] Zudem können durch die Einbindung verschiedenster Publikationsarten Forschung und Praxis vereint und somit wichtige Implikationen für beide Gruppen gegeben werden.[13]

2.1 Systematische Betrachtungsstrategie und Prozess

In dieser Arbeit wurde den drei Schritten Planung – Durchführung – Auswertung nach Tranfield/Denyer/Smart (2003) gefolgt. Jedoch wurden nicht alle Elemente der herkömmlichen SLA-Methode übernommen. Die Autoren entschieden sich insbesondere dafür, keine strikten Qualitätskriterien, wie Theoriefundierung, in den Auswahlprozess einzubeziehen, da die Geschäftsmodellforschung noch nicht sehr weit fortgeschritten ist und die Verfasser dieses Beitrages auch praxisorientierte Beiträge inkludieren wollten.[14]

2.1.1 Planung der Untersuchung

Der Prozess der SLA erfordert deutlich formulierte Forschungsfragen, um den Untersuchungsbereich abzugrenzen. Im Rahmen dieser SLA konzentrieren sich die Autoren auf Literatur mit folgenden Schwerpunkten:

- Studien, die darauf abzielen, eine Definition für Geschäftsmodelle aufzustellen sowie deren Stellung und Aufgaben im Gründungsprozess zu klären;
- Studien, die Geschäftsmodelldesignkonzepte entwickeln; und
- Qualitative und quantitative empirische Beiträge, die Geschäftsmodelle von Unternehmen - insbesondere Gründungsunternehmen - untersuchen.

Zudem wurden in der Planungsphase Erfassungsbögen erarbeitet, mit deren Hilfe die Analyse sowie die Synthese der Abstracts und Artikel und später die Anwendung der Ein- und Ausschlusskriterien erleichtert werden sollten. Diese Bögen enthalten folgende Punkte: Daten zur Veröffentlichung, Ziel der Arbeit, For-

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[12] Vgl. *Pittaway et al.* (2004).
[13] Vgl. *Leseure et al.* (2004).
[14] Vgl. Mäkinen/Seppänen (2007).

schungsfragen, Methodik, Ergebnisse und Schlussfolgerung.

2.1.2 Durchführung der Untersuchung

In diese SLA wurden englischsprachige Journalbeiträge, Konferenzbeiträge, Dissertationen, Buchkapitel und unveröffentlichte Arbeitspapiere einbezogen. Da das Geschäftsmodellkonzept erst in den 1990er Jahren an Popularität gewann, hat das Forschungsteam den Suchzeitraum auf die Jahre 1990 bis 2009 begrenzt.[15]

Die Ausgangssuche begann mit der Sondierung von fünf Entrepreneurship-Zeitschriften, die im Social Science Citation Index gelistet sind.[16] Diese Zeitschriften wurden systematisch nach Artikeln durchsucht, die die Suchwörter „business model“ und „entrepreneur“ im Titel, in den Stichwörtern oder im Abstract enthielten. So konnten elf Beiträge gefunden werden. Aufgrund der geringen Anzahl an Suchtreffern, wurden nach Sichtung der Arbeiten mithilfe einer Brainstorming-Runde sieben weitere Schlüsselwörter durch die Forschergruppe erstellt: „entrepreneur*“, „start-up“, „innovat*“, „strateg*“, „emerging firm“, „venture creation“ und „value creation“.

Im Folgenden wurde die Recherche auf jene vier Datenbanken ausgedehnt, die bereits in anderen Untersuchungen aus dem Bereich Management verwendet wurden (z.B. bei Pittaway/Cope (2007)) und über eine große Bandbreite an Studien und Management-Zeitschriften verfügen: Social Science Research Network, EBSCOhost Online Research Database, Science Direct und Emerald Library Journals. Um auch deutschsprachige Literatur berücksichtigen zu können, wurde zudem eine Literaturrecherche mit äquivalenten deutschen Suchwörtern in der WiSo Datenbank, der Datenbank des Leibniz-Instituts für Sozialwissenschaften „sowiport“ und der Datenbank der WTI Frankfurt eG vorgenommen. Die Suche in den Zeitschriften und Datenbanken erbrachte 1046 Suchergebnisse.

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[15] Die Suchaufträge in den Datenbanken Social Science Research Network, EBSCOhost Online Research Database, Science Direct und Emerald Library Journals wurden im Januar 2010 durchgeführt; die Suchaufträge in den deutschsprachigen Suchmaschinen im Januar 2011.

[16] Die fünf Journale sind das Journal of Business Venturing, The Journal of Small Business Management, Small Business Economics, Entrepreneurship and Regional Development und Entrepreneurship: Theory and Practice.

Von den gefundenen Publikationen wurden 339 Treffer ausgeschlossen, bei denen es sich um Dopplungen handelte sowie weitere 15 Beiträge anonymer Autoren. Die verbleibenden 692 relevanten Veröffentlichungen wurden mithilfe bestimmter Ein- und Ausschlusskriterien (siehe Anhang A und B) untersucht. In Übereinstimmung mit Morgan (2007) erfolgte dieser Schritt in zwei Stufen: Zunächst wurden die Abstracts auf die Ausschlusskriterien hin analysiert; bei den verbleibenden Arbeiten wurden anschließend die Einleitungen anhand der Einschlusskriterien geprüft. Es konnten somit 143 Veröffentlichungen identifiziert werden, welche für die Forschungsfragen dieser Arbeit interessant sind.

Diese 143 extrahierten Publikationen wurden im Weiteren hinsichtlich ihrer Relevanz für die vorliegende Studie in drei Listen (A, B, C)[17] eingeordnet. Dazu wurden jeweils die Abstracts bzw. die Einleitungen mit den Forschungszielen abgeglichen. Letztendlich wurden 63 relevante, 46 teilweise relevante und 34 weniger relevante Artikel identifiziert.

2.1.3 Bericht und Verteilung

Alle Artikel wurden deskriptiv und thematisch aufgeschlüsselt. Aus der deskriptiven Analyse entstanden Tabellen, die das Veröffentlichungsjahr, das thematische Feld, die Publikationsart, den Forschungsansatz und die Einstufung der Zeitschriftenbeiträge beinhalteten. Im Rahmen der thematischen Analyse wurden die Arbeiten mittels einer induktiven Inhaltsanalysetechnik sowie mithilfe des NVivo Software Programms (Version 8) untersucht. Die Abstracts der Veröffentlichungen in der A-Liste wurden in das NVivo Softwarepaket importiert und auf ihren Inhalt hin kodiert, sodass eine Berichtsstruktur für die thematische Analyse erstellt werden konnte. Zusätzlich wurden Literaturangaben aus den Referenzen der gesichteten Arbeiten berücksichtigt.

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[17] In die „A-Liste“ wurden Studien eingeordnet, die auf jeden Fall relevant waren, in der „B-Liste“ fanden sich Beiträge mit mutmaßlicher Relevanz wieder und in der „C-Liste“ wurden Arbeiten festgehalten, die weniger relevant für unser Ziel waren oder deren Charakter noch nicht eindeutig geklärt war.

2.2 Deskriptive Analyse

Unter den 143 Beiträgen befinden sich 103 Zeitschriftenartikel, 19 Arbeitspapiere, vier Buchkapitel und 17 Konferenzbeiträge. Die folgende Abbildung 1 verdeutlicht, wie sich die Anzahl der Beiträge über den Betrachtungszeitraum hinweg entwickelte.

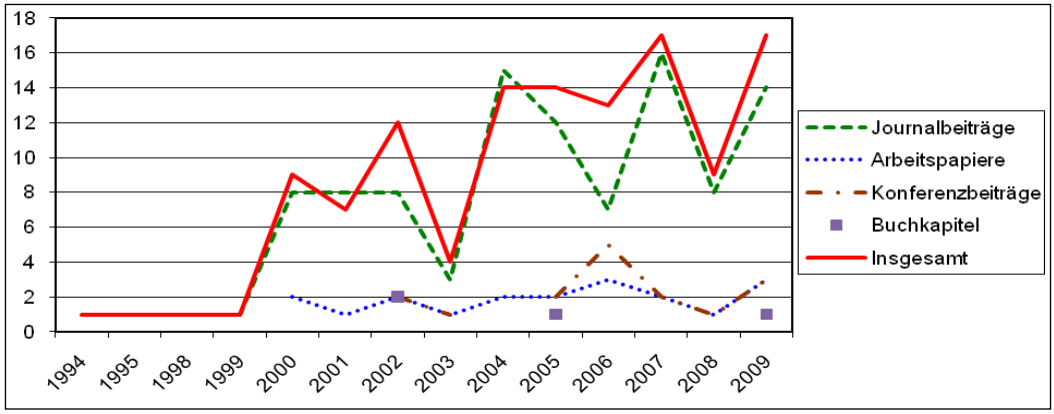

Abbildung 1: Chronologische Entwicklung

Die Darstellung zeigt, dass der Begriff „Geschäftsmodell“ erst seit zehn Jahren häufiger in der akademischen Welt verwendet wird. Der deutliche Anstieg im Jahr 1999 deckt sich mit der vermehrten Nutzung des Internets in der Geschäftswelt und dem rasanten Wachstum des NASDAQ Aktienmarktes. In der Zeit von 1990 bis 2003 wurde der Begriff am häufigsten - jedoch nicht ausschließlich - in Zusammenhang mit dem Internet gebraucht. Danach setzte ein allmählicher Transfer auf andere Bereiche ein.

Die gewählte wissenschaftliche Herangehensweise verdeutlicht, dass die Geschäftsmodellforschung noch immer in den Kinderschuhen steckt. Der Großteil der Arbeiten (71%) verfolgt einen konzeptionellen Ansatz, wohingegen 13% empirischer Natur und nur 4% theoretisch sind. 13% konnten als eine Mischung verschiedener Herangehensweisen klassifiziert werden.

2.3 THEMATISCHE ANALYSE

Die Forschung im Geschäftsmodellbereich entwickelte sich über die Jahre hinweg weiter und obwohl die Wissenschaftler noch nicht auf Arbeiten und Erkenntnissen anderer Forscher aufbauen, kann doch eine Fortentwicklung und damit einhergehend ein Entwicklungsverlauf konstatiert werden. Während des ersten Kodierens wurden 54 Themen ermittelt. Um den Zusammenhang zwischen den induktiv ermittelten Themen zu verdeutlichen, wurde ein thematischer Rahmen als Überblick über die Geschäftsmodellforschung, entwickelt. Dieser betont konzeptionelle Hauptbereiche der Forschung, von denen einigen mehr Aufmerksamkeit zukam als anderen. Alle gemeinsam betrachtet, bieten ein ganzheitliches Verständnis des Forschungsbereichs zu Geschäftsmodellen.[18] Die Forschungsfragen, welche in der Literatur aufgeworfen werden und zur Klärung des Geschäftsmodellkonstruktes beitragen, können in vier Hauptkategorien unterteilt werden: 1) Definition und Aufgabe des Geschäftsmodells, 2) Elemente eines Geschäftsmodells, 3) Stellung des Geschäftsmodells im Gründungsprozess und 4) Veränderung des Geschäftsmodells über die Zeit.

3. ERGEBNISSE

In diesem Kapitel werden allgemeine Erkenntnisse in Bezug auf die herausgearbeiteten Bereiche formuliert, um ein besseres Geschäftsmodellverständnis zu erreichen. Zuerst werden Definitionen und Aufgaben eines Geschäftsmodells, die in der Literatur benannt werden, betrachtet, um anschließend dessen Rolle im Gründungsprozess zu analysieren. An dieser Stelle wird besonders auf die Beziehung zwischen dem Geschäftsmodell- und Strategiekonzept eingegangen. Im Anschluss daran wird die Literatur daraufhin untersucht, ob Geschäftsmodelle statische oder dynamische Konstrukte bilden. Da sich bereits verschiedene Autoren damit be-

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[18] Wir haben im Rahmen der Thematischen Analyse zudem untersucht, ob es einheitliche regionsspezifische Verständnisse der Terminologie „Geschäftsmodell“ und deren Abgrenzung zu den Konstrukten „Business Plan“ und „Strategie“ gibt. Dabei fiel auf, dass in der Praxis „Abnehmer“, wie Finanzierer und Business Angels, individuell vorgeben, was sie genau unter einem Business Plan oder einem Geschäftsmodell verstehen und somit ihr Verständnis vor- und weitergeben.

fasst haben, Literatur zum Thema Geschäftsmodellelemente zu sichten, zusammenzufassen und darauf aufbauend neue Vorschläge zu unterbreiten[19], wird in dieser Arbeit darauf verzichtet diesen Bereich erneut zu beleuchten.

3.1 Definition und Aufgabe des Geschäftsmodells

Aus den 143 analysierten Papieren ließen sich 49 verschiedene Definitionen herauslesen, welche in sechs thematische Gruppen eingeteilt werden konnten: 1) Ökonomisches Modell 2) Wertschöpfungsmodell, 3) Darstellung der Unternehmensorganisation, 4) Wertnetzwerkkonfigurator, 5) Mediator im Innovationsprozess und 6) Innovationskern. Mit diesen Definitionen gehen verschiedene Aufgaben des Geschäftsmodells einher.

Vor allem in frühen Arbeiten wurde das Geschäftsmodell häufig als ein ökonomisches Instrument verstanden, welches einzig und allein die Aufgabe hat, zu errechnen, ob ein positiver Cash-Flow erzielt werden kann.[20] Eng damit verbunden werden Aufgaben beschrieben, wie beispielsweise die Werterfassung[21] in Form der jährlichen Ertragsberechnung.[22] Darauf aufbauend und dieses Konzept erweiternd wird in der Literatur das Geschäftsmodell aktuell am häufigsten als Wertschöpfungsmodell beschrieben.[23] Demnach soll das Geschäftsmodell einerseits die Aufgabe übernehmen, aufzuzeigen, in welchen Bereichen Wert geschaffen wird als auch was von Abnehmern und Konsumenten als wertvoll angesehen wird. Dies wird z. B. in der Inkubatorenliteratur deutlich, die aufzeigt, dass es für das gemeinsame Ziel – Gründungsprojekte erfolgreich in den Markt zu bringen – viele unterschiedliche, wertschaffende und wertschöpfende Ansätze gibt.[24]

Andere Autoren wiederum argumentieren, dass Geschäftsmodelle zum einen dazu beitragen, erfolgreich mit komplexen Sachverhalten, wie Innovationen, umzuge-

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[19] Vgl. Osterwalder/Pigneur/Tucci (2005); Aziz/Fitzsimmons/Douglas (2008).
[20] Vgl. Stewart/Zhao (2000); Rappa (2001).
[21] Vgl. *Chesbrough* (2007).
[22] Vgl. *Teece* (2010).
[23] Vgl. Gordijn/Akkermans/Van Vliet (2000); Amit/Zott (2001); Bieger/Rohr (2002); Chesbrough (2007); Teece (2010).
[24] Vgl. *Alberti* (2011).

hen[25] und zum anderen als eine Art Bauplan unterstützend beim Aufbau sowie der Verwirklichung von Unternehmensstrukturen eingesetzt werden können. Einige Wissenschaftler gehen soweit, sie als Systeme zu beschreiben, die dazu dienen, die interne und äußere Form des Unternehmens zu gestalten[26] inklusive der Schlüsselkomponenten[27] und deren Zusammensetzung.[28] Mit einem mehr externen Fokus sehen verschiedene Verfasser das Geschäftsmodell als Gestaltungstool zur Konfiguration des Wertnetzwerks.[29] In diesem Fall ist es die Aufgabe des Geschäftsmodells, die Positionen der Teilnehmer eines Wertnetzwerkes zu bestimmen und deren optimale Anordnung zu strukturieren.

Darüber hinaus wird das Geschäftsmodell in vielen Studien als ein Konstrukt begriffen, das den Wertschaffungsprozess unterstützt.[30] Es vermittelt zwischen technologischen und ökonomischen Bereichen, indem es Technologien auswählt und mit komplementären Produkten ausstattet, die auf einem ausgewählten Zielmarkt angeboten werden. Diese Sichtweise rahmt das Geschäftsmodell in einen Innovationskontext ein: es wird als kohärentes Gerüst definiert, welches technologische Charakteristika und Potentiale als Einsatz nimmt, um diese in wirtschaftliche Erträge umzusetzen.[31] Mithilfe des Geschäftsmodells wird sichergestellt, dass der technologische Kern der Innovation beim Kunden Wert schafft.

In einer weiteren Forschungsströmung hingegen wird argumentiert, dass Geschäftsmodellinnovation nicht von einzigartigen Technologien oder Produkteinführungen abhängt,[32] sondern das Geschäftsmodell als Bestandteil der Innovationsvermarktung gesehen werden kann, getrennt von Produkt und Prozessinnovation. Dies ist eine zusätzliche Innovationsquelle zu Schumpeters Typologie von

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[25] Vgl. Casadeus-Masanell/Ricart (2007).
[26] Vgl. *Osterwalder/Pigneur*/Tucci (2005).
[27] Vgl. *Hedman/Kalling* (2001).
[28] Vgl. *Magretta* (2002).
[29] Vgl. Timmers, (1998); Slywotzky (1999); Slywotzky (2001); Zott/Amit, (2008).
[30] Vgl. Chesbrough/Rosenbloom (2002); Chesbrough (2004); Chesbrough (2007); Doganova/Eyquem-Renault (2009); Teece (2010).
[31] Vgl. Chesbrough/Rosenbloom (2002).
[32] Vgl. Santos/Spector/van der Heyden (2009).

Innovation.[33] In der Literatur werden zwei verschiedene Formen der Geschäftsmodellinnovation vorgestellt: die radikale Geschäftsmodellinnovation, bei der neue Geschäftsmodelle einen neuen Markt schaffen[34] und die inkrementelle Geschäftsmodellinnovation, welche Neuerungen an Geschäftsmodellelementen vornimmt und diese in bereits existierenden Märkten zum Einsatz bringt.[35]

3.2 Stellung des Geschäftsmodells im Gründungsprozess

Um den Platz des Geschäftsmodells im Gründungsprozess zu bestimmen, erscheint es sinnvoll, die zahlreich geführte Literaturdiskussion zum Thema „Strategie und Geschäftsmodell" näher zu betrachten. Die Meinungen der verschiedensten Autoren gehen hier weit auseinander. Einerseits gibt es Forscher, die der Überzeugung sind, eine so starke Beziehung zwischen den beiden Konzepten zu erkennen, dass sie sich beinahe synonym verwenden lassen, da die Geschäftsmodellforschung viele - wenn nicht alle - theoretischen Komponenten des Strategiekonzeptes aufgreift.[36] Es wird dabei argumentiert, dass in der Anfangsphase die Strategie in das Geschäftsmodell integriert ist[37] und es die konzeptionelle und im Aufbau befindliche Unternehmensstrategie darstellt.[38] Keen/Qureshi (2006) argumentieren darauf aufbauend, dass die Strategie aus einem Geschäftsmodell folgt und darauf abzielt, Wettbewerbsunterschiede zu erreichen. Andererseits gibt es viele Autoren, die auf wichtige Unterschiede hinweisen und damit die Stellung des Geschäftsmodells indirekt herausarbeiten, da die Strategie einen festen Platz im Gründungsprozess inne hat.

Lehmann-Ortega/Schoettl (2005) argumentieren, dass das Geschäftsmodellkonzept dazu beiträgt, eine Brücke zwischen der Strategie und den organisatorischen, kommerziellen bzw. finanziellen Aspekten des Unternehmens zu schlagen. Nach Meinung von Teece (2009) ist eine Verbindung der Analyse von Geschäftsmodel-

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[33] Vgl. *Zott/Amit* (2002).
[34] Vgl. *Kim/Mauborgne* (1999).
[35] Vgl. *Zott/Amit* (2008).
[36] Vgl. *Hedman/Kalling* (2003).
[37] Vgl. *Mair/Schoen* (2005).
[38] Vgl. Bieger/Bischoff/Knyphausen (2002); Osterwalder/Pigneur (2002).

len und Strategien unerlässlich, um einerseits die Ergebnisse der Wettbewerbsanalyse in das Design und die Einführung neuer Geschäftsmodelle zu integrieren und andererseits Rückschlüsse durch die Analyse – vor allem anderer Geschäftsmodelle – auf die eigene Strategie vornehmen zu können. Mäkinen/Seppänen (2006) sind der Meinung, dass Geschäftsprozesse die operativen Einheiten für Strategieelemente sind, die identifiziert wurden und in das Geschäftsmodell eingebunden werden. Betz (2002) betont, dass das strategische Geschäftsmodell eine Technik darstellt, um eine effektive Strategie zu erreichen. Das heißt, dass es eine Auswahl an zukünftigen Vorgehensweisen des Unternehmens bietet, welches es für das Handeln in der Zukunft vorbereitet.

Über die Jahre hinweg wurde in der Literatur ein Konsens darüber erreicht, dass das Geschäftsmodell als ein Hauptkonzept für die Strategieentwicklung gewertet werden kann.[39] Casadeus-Masanell/Ricart (2009) unterstreichen den strategischen Aspekt der Geschäftsmodellfunktion, indem sie erklären, dass ein Geschäftsmodell das Spiegelbild der Unternehmensstrategie darstellt. Außerdem bietet das Gerüst des Geschäftsmodells ein logisches Abbild des Unternehmens, welches für Strategen sehr nützlich ist.[40] Einerseits können Manager ohne ein Geschäftsmodell die Strategie nicht verbessern und die Beschäftigten folglich nicht strategisch handeln,[41] während andererseits eine Strategie benötigt wird, um der Entwicklung des Geschäftsmodells eine Bedeutung und eine Richtung vorzugeben.[42]

3.3 Die Dynamik des Geschäftsmodells

Bisher wurde die Beziehung zwischen Geschäftsmodellen und Zeit kaum in der Forschung thematisiert. Jedoch können sich Geschäftsmodelle sehr schnell verändern,[43] was dazu führt, dass diese Eigenschaft ebenso betrachtet und mit in ein umfassendes Geschäftsmodellverständnis integriert werden muss. Bischofberger/Kobler/Steiner (2005) beispielsweise verfolgen in ihrem Ansatz die Vision

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[39] Vgl. *McGrath* (2009).
[40] Vgl. *Richardson* (2005).
[41] Vgl. *Sandberg* (2002).
[42] Vgl. *Tikkanen et al.* (2005).
[43] Vgl. *Hamel* (2000); *Linder/Cantrell* (2000).

von Geschäftsmodellen in der Finanzdienstleistungsbranche, welche dynamische Konstrukte darstellen, die sich flexibel und schnell an neue, sich stets ändernde externe Anforderungen, wie dem Wandel von Kundenbedürfnissen, anpassen lassen. Die Zeiten, in denen ein Unternehmen mit dem bestehenden Geschäftsmodell Geld verdienen kann, verkürzen sich, weshalb Senger/Suter (2007) dem Thema Differenzierung, also der systematischen Entwicklung innovativer Geschäftsmodelle, eine hohe Priorität einräumen.

Obwohl Forscher nicht notwendigerweise stets dieselben Begriffe benutzen, um den Übergang eines gegenwärtigen Geschäftsmodells hin zu einem zukünftigen Geschäftsmodell zu bezeichnen, so tauchen doch immer wieder bestimmte Ausdrücke in den relevanten Ansätzen auf, wie „Transformation", „Steigerung", „Ausweitung", „Wandel" und „Entwicklung".[44] Einige Autoren betonen, dass Geschäftsmodelle einer gewissen Dynamik unterliegen, die von vielfältiger Herkunft rührt. Diese lässt sich zum einen zwischen dem internen Wunsch nach Gewinnstreben oder Unternehmenswachstum[45] und zum anderen den externen Einflüssen, wie Technologieinnovationen, Gesetzesänderungen, Wettbewerbsdruck oder wechselnden Konsumenteneinstellungen unterscheiden.[46] Andries/Debackere (2006) weisen darauf hin, dass hauptsächlich das Vorhandensein von Unsicherheiten und Unklarheiten für den Wandel neuer technologiebasierter Unternehmen verantwortlich ist. Ferner fanden de Reuver/Bouwman/MacInnes (2009) und Bouwman/MacInnes (2006) heraus, dass externe Faktoren einen bedeutenden Einfluss auf Existenzgründungen ausüben, dieser jedoch mit der Zeit nachlässt. Insbesondere Technologie und Marktkräfte spielen eine entscheidende Rolle, wohingegen Normen und Gesetze eher eine untergeordnete Position einnehmen. Beispielsweise spürte das Informations- und Kommunikationstechnologie Unternehmen IBM in seiner jahrelangen Unternehmensgeschichte, dass Innovationen nach komplementären – und teilweise sehr grundlegenden – Anpassungen des Geschäftsmodells verlangen, damit das Unternehmen weiterhin erfolgreich bleiben

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[44] Vgl. *Pateli/Giaglis* (2002).
[45] Vgl. Morris/Schindehutte/Allen (2005).
[46] Vgl. Linder/Cantrell (2000); Hedman/Kalling (2003); Bischofberger/Kobler/Steiner (2005).

kann.[47] Neuartige Geschäftsmodelle verändern nicht nur das Leistungsangebot des Unternehmens, sondern beziehen sich auch auf den Vertriebsansatz, das Erlösmodell, die Prozessstrukturen und das Partnernetzwerk.[48]

Während einige Studien wegabhängige Veränderungen zwischen alten und neuen Geschäftsmodellen bei Produktionsfirmen[49] und Biotechnologieanbietern[50] gefunden haben, deuten andere Forschungsansätze darauf hin, dass die Entwicklung von Geschäftsmodellen an sich unsicher und nicht projizierbar ist.[51] Allgemeine Mechanismen, die zu einer Entwicklung von erfolgreichen oder dominanten Geschäftsmodellen führen, blieben bisher unentdeckt.

Im Rahmen eines weiteren Forschungsstranges konzentrieren sich Autoren auf die Erforschung von Methoden, mit denen die Weiterentwicklung oder Änderung von Geschäftsmodellen unterstützt werden kann. Petrovic/Kittl/Teksten (2001) und Auer/Follack (2002) plädieren für eine Methodologie, die auf den drei Lernstufen sowie auf einer Vielzahl von Systemtheorien, wie Systemdynamiken basiert. Pateli/Giaglis (2003) schlagen in einem nachvollziehbareren Ansatz eine Methodologie für die Entwicklung von Geschäftsmodellen vor, die auf der Identifizierung alternativer Szenarios basiert. Jedes Szenario stellt die Beschreibung einer anderen Art und Weise für die Verteilung von Verantwortlichkeiten, das Schließen von Verträgen für Partnerschaften und das Sicherstellen von Einnahmen für das Geschäftsmodell dar.

4. DISKUSSION

Das Geschäftsmodell ist in den letzten Jahren zentraler Bestandteil vieler Diskussionen in der Praxis und Forschung geworden. Viele Autoren haben sich dem Phänomen angenommen und durch ihre Arbeit zum besseren Verständnis beigetragen. Trotz der immer noch sehr weit auseinandergehenden Definitionen kann festgehalten werden, dass das Geschäftsmodell nicht nur dazu dienen kann, eine

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[47] Vgl. *Jetter/Satzger* (2009).
[48] Vgl. *Senger/Suter* (2007).
[49] Vgl. Lovins/Lovins/Hawken (1999).
[50] Vgl. Willemstein/van der Valk/Meeus (2007).
[51] Vgl. Heirman/Clarysse (2004).

Gelegenheit zur Wertschaffung zu nutzen, sondern die Entwicklung desselben Teils des Prozesses zur Gelegenheitsentwicklung sein kann: der Unternehmer kann als Geschäftsmodellentwickler Gelegenheiten schaffen. Zudem stimmen die Autoren darin überein, dass das Geschäftsmodell eines Unternehmens, unabhängig davon wie erfolgreich und überlegen es ist, von Wettbewerbern mit der Zeit imitiert und herausgefordert wird und damit Wandel eine Voraussetzung für langfristigen Erfolg ist. Diese Dynamik verbindet das Geschäftsmodell und das Strategiekonzept. Das Geschäftsmodell ist ein wichtiges Konstrukt, welches einerseits die Strategieentwicklung beeinflusst und andererseits Ergebnisse dieses Prozesses aufnimmt und umsetzt (siehe Abbildung 2).

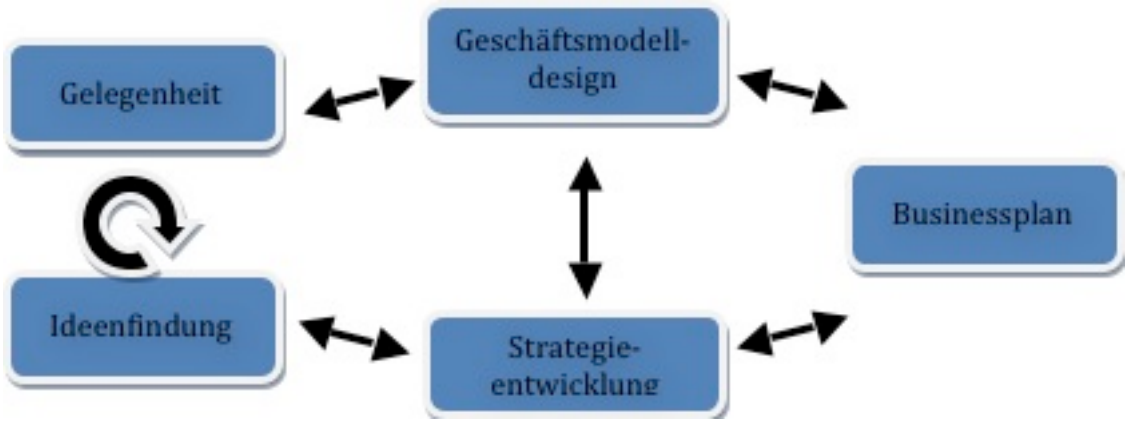

Abbildung 2: Das Geschäftsmodell im Unternehmensgestaltungsprozess

Für den Gründungsprozess bedeutet dies, dass die Phase zwischen dem Finden der Idee und dem Erstellen des Business Plans wichtiger ist, da viele Informationen zu sammeln und zusammenzufügen sind, als dies bisher in den meisten Darstellungen angegeben wurde. In dieser Phase – der Phase Geschäftsmodellentwicklung – kann das Geschäftsmodell als Gestaltungstool den Mittelpunkt einnehmen, um Unternehmensgründungen erfolgversprechend vorzubereiten. Das Geschäftsmodell ist ein flexibleres Konstrukt als der Businessplan und birgt deswegen viel Potenzial, den Prozess der Unternehmensgestaltung besser zu unterstützen.

5. ZUSAMMENFASSUNG DER ERGEBNISSE UND SCHLUSSFOLGERUNGEN

Die Geschäftsmodellforschung wurde bisher von Studien dominiert, die Gesch-

ftsmodelldefinitionen sowie dessen Elemente vorstellen. Die Begriffsbeschreibung in diesem Forschungsbereich führte zu unzähligen Konzepten, Ontologien und Strukturen von Geschäftsmodellen, von denen jedes für sich von Wert ist, jedoch keines als allgemein anerkannt gesehen werden kann. Bei näherer Betrachtung kann festgestellt werden, dass bereits existierende Geschäftsmodellsystematiken tatsächlich auch Typologien sind, aber nur begrenzt bzw. sehr speziell genutzt werden. Es gibt keine universelle Geschäftsmodellsystematik, da kein allgemein anerkanntes Geschäftsmodellkonzept existiert. Umbeck führte Interviews mit Praktikern durch und erkannte, dass das diverse Verständnis des Geschäftsmodell-Konzepts auch in der Praxis besteht. Es scheint hier ein gänzlich individuelles Verständnis von Geschäftsmodellen sowie ihrer Definition vorzuliegen. Der Wert einer systemischen Darstellung konnte von den Praktikern bestätigt werden, jedoch muss eine an die jeweilige Firmensituation angepasste Modellierung erfolgen.[52]

Derzeitig ist die Forschungsgemeinschaft dabei, eine gemeinsame Sprache zu kreieren, damit Geschäftsmodelle auf einer gemeinsamen, ganzheitlichen Basis sowohl in der Forschung als auch in der Praxis diskutiert und analysiert werden können.[53] Um dies zu erreichen, müssen vermehrt Anstrengungen in der Forschung unternommen und das Geschäftsmodellkonzept in die Lehre übernommen werden.

5.1 Zukünftige Forschungsfelder

Auf Basis dieser SLA lassen sich insbesondere drei Themenfelder herausstellen, die zunächst weiter erforscht werden müssen.

Geschäftsmodellentstehung

Bisher gibt es nur wenige Forschungsbeiträge zu dem Thema, wie Geschäftsmodelle entstehen. Morris/Schindehutte/Allen (2005) beschreiben den Lebenszyklus eines Geschäftsmodells mit den Phasen der Präzision, Verfeinerung, Anpassung,

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[52] Vgl. *Umbeck* (2009).
[53] Vgl. *Pateli/Giaglis* (2004).

Überarbeitung und Reformulierung. Jedoch erfolgt die Darstellung relativ ungenau. Es wird prognostiziert, dass es eine Phase des Erkennens der Gelegenheiten gibt, in der das Modell noch ziemlich informell und ungenau ist. Daran könnte sich die Phase der Erprobung und Untersuchung auf Fehleranfälligkeit anschließen, woraufhin viele wichtige Entscheidungen getroffen werden, die die Entwicklungsrichtung des Unternehmens eingrenzen. Danach liegt ein relativ formelles Modell vor, an dem Anpassungen und weitere Versuche vorgenommen werden. Somit verändern Unternehmer ihr Geschäftsmodell zu einem noch formelleren und verständlicheren Modell. Eine longitudinale Studie dieses Prozesses könnte Gründern und Entrepreneurship-Ausbildern helfen, den Prozess der Geschäftsmodellentstehung besser zu verstehen und unterstützen und damit zum erfolgreicheren Markteintritt beitragen.

Geschäftsmodellentwicklung über die Zeit

Während die Gründe für die Anpassung von Geschäftsmodellen über die Zeit schon umfassend erforscht wurden, besteht in Bezug auf den Prozess und die Struktur, wie Unternehmen den Übergang von der Erkenntnis von Gelegenheiten hin zum Management der Gelegenheiten und der Markterschließung, noch erheblicher Forschungsbedarf. Um diesen Prozess zu verstehen und zu unterstützen, ist es notwendig, dass die Entwicklung von Geschäftsmodellen bei Existenzgründungen untersucht wird.[54] Weiterhin wird mehr Forschung zur Klärung der Verbindung zwischen Geschäftsmodellen und Organisationswandel benötigt sowie zwischen Geschäftsmodellen und den internen Mechanismen bzw. Prozessen, die zu einem Wandel führen. Abschließend kann festgehalten werden, dass ein methodologischer Ansatz, der den Unternehmer durch den Prozess der Geschäftsmodellentwicklung führt und Finanzdaten für die Evaluierung beinhaltet, fehlt. Es wäre insbesondere wichtig, Erfolgs- und Misserfolgsfaktoren zu bestimmen und in den Ansatz zu integrieren, welche dem Gründer oder auch Externen als Reife-, Güte- oder Warnsignal dienen können.[55] Insbesondere könnte es interessant sein, dies für

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[54] Vgl. *George/Bock* (2009).
[55] Hierzu hat *Kollmann* (2003) einen ersten, praxisorientierten Ansatz entwickelt, in dem er den Werdegang des Gründungsunternehmens als mehrstufigen Prozess

schnell wachsende Unternehmen zu untersuchen, da diese sicher mit der Zeit formellere, verständlichere und effiziente Modelle benötigen, um richtungsweisend zu arbeiten, den Ressourceneinsatz zu optimieren und bessere Wertschöpfungspartner zu gewinnen.

Geschäftsmodelle und Unternehmenserfolg

Im Allgemeinen ist das Geschäftsmodell mit dem Fortbestehen des Unternehmens sowie mit seinem langfristigen Erfolg verknüpft.[56] Allerdings muss die Forschung in diesem Bereich über Produkte und Transaktionscharakteristika hinweg ausgeweitet werden. Es ist wahrscheinlich, dass neue Daten erhoben werden müssen, um Aspekte von erfolgsversprechenden Geschäftsmodellstrukturen bewerten zu können. Eigenschaften dieser Strukturen könnten differenziertere Bemessungen erfordern. Diese Forschung bietet die Möglichkeit, Studien mit der Forschung zum Organisationswachstum zu verbinden, indem Modelle zum Einfluss von Geschäftsmodellstrukturen auf Degressionseffekte, Diversifikationsvorteile sowie auf Legitimierungseffekte entwickelt werden.

5.2 Konsequenzen für die Gründungsausbildung

Eine innovative Idee oder ein innovatives Produkt sind zwar für den unternehmerischen Erfolg notwendig, jedoch lange noch nicht hinreichend. Diese SLA sollte deutlich machen, dass unter anderem die Ausbildung von Unternehmensgründern sich nicht auf die Finanzierung der Vermarktung einer Innovation beschränken darf, sondern sich auf die Ausformulierung des Geschäftsmodells konzentrieren muss. Unternehmenskrisen haben häufig nicht ihre Ursachen in falschen Finanzierungs- oder Marketinginstrumenten, sondern in einem unzureichend formulierten und nicht über die Zeit weiterentwickelten Geschäftsmodell.

Das durchdachte Geschäftsmodell kann somit neben der Persönlichkeit des Unternehmers als zentraler Erfolgsfaktor – und damit als Schlüssel in der Entrepre-

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abbildet und diesen mit Erfolgskriterien verbindet, um dadurch die Werthaftigkeit der Geschäftsidee zu prüfen.

[56] Vgl. *Zott/Amit* (2007).

neurship-Ausbildung – angesehen werden. Die Kunst des Verfeinerns der ersten Idee ist eine Leistung, die persönliche Eigenschaften mit betriebswirtschaftlichen Fähigkeiten kombiniert. Für die Hochschulen, an deren natur- und ingenieurwissenschaftlichen Fakultäten viele Innovationen entstehen, bedeutet dies, dass der Transferprozess sowie das Wissen über die Kombination von verschiedensten Elementen entwickelt werden müssen. Die Fähigkeit zum Erkennen und Nutzen von ökonomischen Chancen rückt so in den Mittelpunkt des Ausbildungsinteresses.

Hierfür wäre es vor allem hilfreich ein Geschäftsmodelltool mit Visualisierungsmöglichkeiten zu erschaffen, welches ein einfaches und strukturiertes Vorgehen bei der Ausbildung ermöglicht.

6. LIMITATIONEN

Wie auch bei anderen Methoden existieren Einschränkungen einerseits bei der Methodologie an sich und andererseits durch die Anwendung in der vorliegenden Studie. Zum einen führte die Auswahl der acht Suchwörterkombinationen dazu, dass relevante Studien nicht in Betracht gezogen werden konnten, die mit anderen Stichwörterkombinationen verbunden waren. Zum anderen wurden nur Beiträge berücksichtigt, die in der englischen Sprache verfasst wurden, weshalb das vorliegende Paper nicht als allumfassendes Ergebnis der internationalen Geschäftsmodellforschung angesehen werden kann. Jedoch ergab unsere deskriptive Auswertung der Autoren, dass insbesondere europäische und nordamerikanische Forschungsergebnisse gut abgebildet wurden. Eine ergänzende Recherche zu Arbeiten im asiatischen und südamerikanischen Bereich könnte eine sinnvolle Ergänzung sein.

Eine letzte Beschränkung für diesen Beitrag ergibt sich aus dem Grundanliegen, eine thematische Analyse zu erstellen. Das Ziel diesbezüglich war es, sich mit der Geschäftsmodellforschung zu beschäftigen und eher Leitmotive in der Literatur aufzudecken als empirische Beweise in einer verständlicheren Art und Weise zusammenzufassen. Die Verwendung der NVivo Software zur Kodierung und Analyse von Artikeln ist freilich effektiv, um eine thematische Analyse durchzuführen, jedoch weist sie anerkannte Schwächen auf. Beispielsweise ist sie von der

Qualität der geschriebenen Abstracts abhängig.[57] Dem entgegengewirkt haben die Autoren indem sie alle Abstracts selbst noch einmal gelesen und bei Unsicherheiten weitere Textstücke für die Kodierung verwendet haben.

Zusammenfassend kann festgehalten werden, dass eine SLA, wie andere Methodiken auch, Schwächen aufweist. Allerdings liegt ihre große Stärke, wie bereits gezeigt wurde, darin, dass mit ihrer Hilfe umfassende Literaturuntersuchungen durchgeführt werden können. Dabei handelt es sich um eine transparente Methode, welche Überprüfungen erlaubt und replizierbar ist. Nach Meinung der Autoren kann dies als eine Verbesserung im Bereich der narrativen Literaturübersichtsformen gewertet werden, die nicht transparent und normalerweise auch nicht überprüfbar sind. Die Autoren hoffen, dass dieser Beitrag andere Forscher dazu ermuntert, diese Methodik anzuwenden und sie dadurch stärkeren Einzug in die wirtschaftswissenschaftliche Forschung nimmt.

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[57] Vgl. *Pittaway et al.* (2004).

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Anhang A: Einschlusskriterien

Nr.	Kriterium	Grund für den Einschluss
1	Konzeptionelle Ansätze, die darauf abzielen, das Geschäftsmodellkonzept sowie seine Aufgaben im unternehmerischen Kontext zu klären	Sie bieten Arbeitshypothesen, die für diese SLA genutzt werden können.
2	Studien, die sich dem Geschäftsmodellkonzept aus einer Designperspektive nähern	Sie bieten Arbeitshypothesen, die im Bereich Entrepreneurship wertvolle Grundlagen bilden können.
3	Qualitative und quantitative empirische Studien	Sie erfassen alle empirischen Beweise.
4	Arbeitspapiere und Konferenzbeiträge	Dadurch können die aktuellsten Forschungsansätze berücksichtigt werden.

Anhang B: Ausschlusskriterien

Nr.	Kriterium	Grund für den Ausschluss
1	Studien, die das Geschäftsmodellkonzept nur für einen bestimmten Industriezweig anwenden, z.B. Musikindustrie	Kontextbezogene Anwendungen schränken die allgemeine Anwendbarkeit ein.
2	Studien, die das Geschäftsmodellkonzept auf einen spezifischen Managementbereich beziehen, z.B. Marketing	Ein kontextabhängiges Verständnis des Begriffs Geschäftsmodell schränkt die allgemeine Anwendbarkeit ein.
3	Irrelevante Erwähnung im Text aufgrund grammatikalischer Übereinstimmung	Es besteht kein Bezug zur Forschungsfrage dieser SLA.
4	Einmalige Erwähnung des Wortes ohne Erklärung oder ohne Bezug zu Unternehmen / Existenzgründungen	Es handelt sich um eine alleinige Erwähnung des Begriffs. Diese Beiträge klären nicht das Geschäftsmodellkonzept.
5	Mehrfachnennung ohne bedeutende Ausführungen zum Konzept oder zur Entwicklung von Geschäftsmodellen	Es handelt sich um eine alleinige Erwähnung des Begriffs. Diese Beiträge klären nicht das Konzept.
6	Datenverarbeitungs- und Prozessmodellierungsforschung	Studien aus diesem Bereich berichten hauptsächlich von Ansätzen zur Prozessmodellierung.
7	Fallstudien und Interviews	Diese Beiträge konzentrieren sich auf die Anwendung des Konzepts und nicht auf seine Klärung.

PAPER 2

Business Model Metamorphosis in Earl-Stage Ventures

Franziska Günzel & Helge Wilker

Abstract

This paper discusses the need to expand the existing conceptualization of the business model concept by adding a dynamics component. By applying a novel entrepreneurship-centric framework for business model analysis to 50 case studies, three different patterns of business model development are determined: (i) scale, (ii) scope, and (iii) re-emerging. Additionally, a complexity measure is introduced and used to identify the complexity curve pattern. Based on the findings, it is proposed to use the business model as a trial-and-error as well as a design tool to support entrepreneurs, educators, and stakeholders in the business model metamorphosis process.

Keywords: business model, change, dynamics, entrepreneur, metamorphosis, multiple case study, start-up

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1. INTRODUCTION

New businesses often start either from a market vision or from a technological capability. In both cases, the initial idea must be exploited with the aid of a business model (Chesbrough and Rosenbloom, 2002; Hamel, 2000). The example of Google illustrates this perfectly. The firm started merely with a new technology for Internet search that proved wildly successful with users due to its extraordinary utility, but with no idea whatsoever of how to make money from that. This was solved after some time when the firm invented yet another clever technology for selling space to advertisers on the users' search result web pages. The advertisers thus became Google's customers, in the sense of giving them money in return for a service. Search users, who might naively be seen as the obvious candidates for the customer role, turned out to be a part of Google's product. This realization, based on identifying the relevant actors and their various relationships, can be captured and illuminated very well with the help of a *business model*.

The term 'business model' is currently widely used, but the concept is very rarely studied systematically (Magretta, 2002; Porter, 2001; George and Bock, 2011; Morris et al., 2005). Business models as a concept are regarded as important in both research and practice, but still lack a uniform definition or taxonomy (Lambert, 2006; Magretta, 2002; Osterwalder, 2004; Timmers, 1998). This lack of consensus may in part be attributed to the wide range of disciplines that show interest in the concept, all of which have arrived at a different – mostly industry-specific – understanding (e.g., Rajala and Westerlund, 2007).

With a few exceptions (Andries et al., 2008; MacInnes, 2005; Vaccaro and Cohn, 2004), most literature on business models has taken a static perspective, implicitly assuming them to remain stable over time. However, as Brokaw (1991) found, a large fraction of firms change the initial market offering, the network, and the value creation logic and thus their business model. Additionally, studies show that it is this change that is crucial to success and survival of new ventures (Bamford et al., 2000; Hanks et al., 1993; Kazanjian and Drazin, 1990; Reynolds and Miller, 1992). While reasons for business model adaptation are researched to a certain extent (e.g. de Reuver et al., 2009), the process and structure of how new ven-

tures' transition through the initial life-cycle phases – opportunity recognition, market entry, and market exploitation – remain under-investigated (George and Bock, 2011). To understand and support this process, an analysis of the metamorphosis undergone by start-up business models, including the identification of patterns of different types, is needed.

This paper aims to present this analysis by exploring the evolution of 50 start-up companies from opportunity recognition to market entry and market exploitation. Thereby, we make three important contributions to the field of entrepreneurship. First, by incorporating the macro and micro level, we suggest a novel framework for the analysis of business model metamorphosis that is especially suitable to the entrepreneurship context . Second, by using a multiple case study approach, we identify three *patterns of development* and the *complexity curve*, giving in-depth insight into how business model metamorphosis takes place. Third, we offer several practical implications of our findings for practicing entrepreneurs, start-up support programs, and policy-making.

2. LITERATURE REVIEW

Numerous studies suggest that ventures change during their life cycle and that this change is crucial to their success and survival (for an overview, see Bamford et al., 2000; Hanks et al., 1993; Kazanjian and Drazin, 1989; Kazanjian and Drazin, 1990; Reynolds and Miller, 1992; Vesper, 1990). Most of this literature argues that companies progress through different stages during which specific growth and market opportunities (e.g., Chandler, 1962; Scott, 1971) as well as challenges (Greiner, 1972; Kazanjian and Drazin, 1989) and demands (Siggelkow and Levinthal, 2005) must be addressed through the use of adequate skills and appropriate organizational structures. In current literature, it is argued that the design of new, or later on the revision of existing, business models plays an important role in this process (Sosna et al., 2010). Early business model research presented a static perspective, whereas recent studies have acknowledged that initial business models are frequently revised and adapted, but it remains undetermined how start-ups evolve and transform their business models.

2.1 BUSINESS MODELS IN ENTREPRENEURSHIP RESEARCH

In venture creation, some authors consider it essential to have a clearly articulated business model as early as possible, since it is the central construct to coordinate start-up activities and thus to cope with complexity and uncertainty (Barringer and Ireland, 2007; Sandberg, 2002). This is one reason why the business model receives more emphasis in the recent entrepreneurship literature (e.g., Morris et al., 2005; George and Bock, 2011).

Morris et al. (2005), George and Bock (2011) and Amit and Zott (2011) provide good summaries of the existing business model literature. They conclude that research so far has focused on providing definitions of a business model and identifying its elements. A common finding in these studies is that despite the divergence in existing approaches, business model concept-building, and empirical research appear to germinate from established organizational topics such as strategic choice, resource accumulation, and innovation – which, since these approaches target generally established and large firms, makes the majority of them not adaptable for start-ups.

In the field of entrepreneurship, the business model is described in numerous ways: as a facilitative intermediary in the opportunity creation process (Amit and Zott, 2001), as the link between innovation and value creation (Chesbrough and Rosenbloom, 2002) or as the cognitive link between entrepreneurial appraisal of the opportunity and its exploitation (Fiet and Patel, 2008). Other authors (e.g. Afuah and Tucci, 2003; Markides, 2008) equate the business model to the underlying'business idea', the firm's value creation mechanism or even a form of entrepreneurial opportunity creation itself. The difference between approaches is also manifested in the scope of current business model concepts: some researchers use enterprise models as the basis for the business model and therefore include internal organizational processes, whereas others employ the business model primarily to depict the relationships with external entities within their domain (Lambert, 2003). Thus, some definitions are detailed and encompassing of all business functions (Chesbrough and Rosenbloom, 2002; Dubosson-Torbay et al., 2002; Mahadevan, 2000) while others are quite abstract with the business network as

their main subject (Hamel, 2000; Hawkins, 2002; Timmers, 1998; Weill and Vitale, 2001).

The lack of a consistent framework has resulted in fragmented research approaches and thus findings that are not easy comparable. George and Bock (2011) conclude that rigorous research on business models in the field of entrepreneurship remains in a nascent stage. The is especially true concerning business model evolution, which authors only started focusing on very recently.

2.2 Business Model Evolution – A Dynamic Perspective

While the need for business model re-invention is well-established (Andries et al., 2008; MacInnes, 2005; Osterwalder, 2004), there is still a tendency in the literature towards examining business models at a single moment in time – mostly ex-post at some notionally finished stage – while an analysis of the business model's development is disregarded (exceptions can be found in Andries and Debackere, 2006; MacInnes, 2005; Vaccaro and Cohn, 2004; Sosna et al., 2010). In addition, the term ‘re-invention’ often refers to a single occurrence: the business model is changed once after a pivotal change in the firm's industry. In reality however, organizations often have to adapt their business model continuously to deal with e.g. changing technology, market, and regulatory conditions (Afuah and Tucci, 2003; de Reuver et al., 2009). The choice of business model design that appear to be fixed when a product or service concept is initially developed often needs to be adapted after launch and for market exposure.

Additionally, it should be mentioned that there are only a few genuinely general approaches to the subject of business model change – general in the sense of industry, firm size, and time frame. Linder and Cantrell (2000) develop their approach based on the corporate strategy viewpoint. Afuah and Tucci (2003) examine the implications of Internet-based creative destruction but use whole industries as their subject and provide no results about single firms. Gordijn and Akkermans (2001) provide a mechanism for creating design variations on e-business models but do not use this to look for general patterns in a larger sample of firms. Other studies are limited in scope: they mostly try to answer the question of how con-

ventional firms can move to an e-business model, and handle this question as an on-off occurrence (e.g. Weill and Vitale, 2001; Tapscott, 2001).

The phenomenon of 'business model evolution' still lacks theoretical grounding which would give a better understanding of its underlying mechanism and move the "still shaky conceptual frameworks" of business models to more solid theoretical grounds (Sosna et al., 2010, p.385). This paper aims to fill this gap by examining the evolution of business models in early-stage ventures. We thereby determine how processes and structures change as firms transit from opportunity recognition to market exploitation, and we aim to identify common patterns in business model evolution. The results of the survey described in this paper present promising directions for re-conceptualizing the business model along these lines and provide theoretical grounding to the dynamic view on business models.

3. CONCEPTUAL FRAMEWORK

Since there are very few studies on business models that account for business model evolution, we cannot rely on existing research approaches. Several scholars call for the incorporation of macro (network or environment) and micro (firm or internal) level considerations in new entrepreneurship research to better understand its phenomenon and the underlying processes (Davidsson and Wiklund, 2001; Steyaert and Katz, 2004). Even with the tremendous expansion of the field, most entrepreneurship research still either focuses on the micro level and draws conclusions about macro outcomes, or begins with the macro level and infers specific entrepreneurial behaviors. This either-or approach is problematic for the analysis of business models, because sources of value creation and capture that influence the start-up and its development are found at all levels (Morris et al., 2005). Therefore, it is required to find a business model approach that covers both micro and macrolevel aspects, taking into account both the firm and the network level without favoring either one.

Amit's and Zott's (2001) view of the business model fulfills these criteria. The authors define the business model as a unifying mechanism describing the "content, structure, and governance of transactions" (Amit and Zott, 2001, p. 511). By

putting a clear focus on value creation, value capture, and opportunity recognition, their concept provides a firm foundation for this study. *Content* here describes the elements of the transaction (goods, information, and money being exchanged). The network of parties and the rules for enacting the transaction itself (temporal, order) are covered by *structure*. *Governance* describes controlling influences exercised by the parties involved in the transactions. The authors later update their approach by pointing out that the business model also "represents a conceptualization of the pattern of transactional links between the firm and its exchange partners" (Zott and Amit, 2008, p. 3). This inclusion of external linkages is crucial for the analysis of the business models of start-ups.

In accordance with Santos et al. (2010), we find that the updated definition of Zott and Amit (2008) still lacks one vital aspect by not considering the relationship and network aspects to the necessary extent. It is exactly this aspect of a business modelwhere changes between the phases of a venture's development are most salient (Liao and Welsch, 2005). This includes social, political and interpersonal dimensions (Santos et al., 2010). The exchange of information depends on the nature of social networks and the quality of relationships among the individuals engaged in the exchange (Borgatti and Cross, 2003; Abrams et al., 2003; Levin and Cross, 2004). The intention to change and the actual execution of changing a business model can be improved or hampered by relationship aspects and they are thus important to include in the business model metamorphosis analysis.

By adding the previously missing relationship dimension to the business model approach of Zott and Amit (2008), we arrive at the following definition of the business model concept for our analysis (see tab. 1):

> *"The business model is the configuration of transaction structure, content and governance as well as the organizational and personal network structure that describes how value is created and captured in order to act upon and exploit business opportunities."*

The value notion additionally embedded in this definition determines the system of rules, expectations, and mechanisms that affect the firm's value creation and

capture activities in the context of opportunity exploitation. It is especially this part that makes our approach entrepreneurship-centric since it is the mediation of these two aspects – "the fundamental opportunity and the entrepreneur's perception of the opportunity landscape" (George and Bock, 2011, p. 101) – that forms the basis for any entrepreneurial action. The value system is the underlying foundation in this business model definition that strongly influences the alignment of the transaction components.

	Transaction Content	**Transaction Structure**	**Transaction Governance**	**Relationships**
Business Model Element	The goods or information being exchanged, and the resources to enable the exchange	The parties involved in the exchange, how they are linked, the order in which exchanges take place, and the exchange mechanisms adopted for enabling transactions	The ways in which flows of information, resources, and goods are controlled by the relevant parties, the legal form of organization, and the incentive for transaction participation	Connections between parties that are not covered by transaction content
Sub-element	Goods Information Resources Services	Actors Distribution channels Exchange mechanism/Payment structure	Influences Legal form Pricing Regulations Revenue system	Motivation Strength of relationship

Table 1: Business model framework

A framework for business model metamorphosis analysis furthermore requires a way to formalize time i.e. the life cycle stages through which the start-up proceeds. Taking account of the literature on phase models (Andries and Debackere, 2006) and adapting the framework for business model dynamic analysis from de Reuver et al. (2009), one can broadly speak of three main life cycle phases of a start-up's business model: opportunity realization, market entry, and market ex-

ploitation, all phases of which consist of sub-phases and possible feedback loops.

In the opportunity realization phase, the entrepreneur typically focuses on technology, funding, and the development of product or service concepts. The offering, the technology and the business model are in a pre-market-stage and therefore subject to change. The shift to the market entry phase is characterized by testing service concepts, field experiments, first introduction and small-scale rollouts. In the market entry phase, companies especially focus on finding initial customers, which may have implications for the network partners involved. The third phase is then characterized by a shift to commercial exploitation. In the market exploitation phase, companies try to find new customer segments, become profitable and develop the next version of the offering to market.

Because different actors, relationships, and resources are needed in each of these phases, we propose that business models are subject to change in general. We further propose that these changes in business models occur in different, distinguishable shapes. First, the business model applied in the beginning by newly founded firms can change over time. Secondly, firms can shift from one business model to another. Such shifts are triggered e.g. through learning on the part of the entrepreneurs, by the emergence of new profit-generating opportunities that need to be exploited to enable firm survival or growth or by newly available resources that the firm can utilize. We therefore expect to find identifiable patterns in the process of business model metamorphosis.

4. RESEARCH DESIGN AND APPROACH

The goal of this explorative study is to gain a deeper understanding of business model metamorphosis in early stage ventures. According to Yin (2002) and Flyvbjerg (2006), the key factors that underlie the proposed study, such as the complexity of the research topic, the nature of the study, the type of research questions and the research purpose, suggest the use of a qualitative methodological approach, in particular, multiple case studies, which is a preferred method to study a complex social phenomenon deeply embedded within its real-life context (George and Bennett, 2005; Hancock and Algozzine, 2006; Stake, 2005; Yin,

2009). In line with this, Gartner and Birley (2002) regard multiple case studies research as an especially useful tool to understand the complex nature of entrepreneurship.

We used the following steps in our analysis: selection of case studies and identification of additional information sources relevant to the research question; designing a coding scheme for systematic analysis of all case descriptions; use of multiple raters to code the cases and measure their inter-rater reliability; and finally, analysis of the coded data.

4.1 CASE SELECTION

In the last decade, not only did the volume of academic literature investigating the business model concept increase tremendously, but also case studies examining the business model of start-ups and existing companies and their development gained wide coverage. Taking advantage of this situation, we decided to build upon this existing data; first, searching for available cases, and then complementing the data set with additional ones according to our purposeful sampling strategy. To prevent sample bias and guarantee maximum variation, the case search involved computerized and manual searches of published and unpublished cases. Computerized searches were performed on the following databases: Social Science Research Network, EBSCOhost Online Research Database, Science Direct and Emerald Library Journals. Other search strategies included screening case catalogues (especially case bibliographies from various business schools), Internet search using standard search engines such as Google, as well as manual searches in relevant books and pertinent research journals. Additionally, we screened written project reports from projects that took part in spin-off support programs at our university. More than 130 cases were identified through this process. These cases were then screened for completeness and relevance.

The businesses presented in the case descriptions had to meet the following criteria to be included in our study:

1. Independence – The businesses were not part of, or owned by, large companies.

2. Industry - The businesses operated in the following sectors: information technology, retail, medicine, business and professional services, engineering, and logistics. This allowed the exploration of a variety of business model evolution paths, but within a small range of sectors (Eisenhardt, 1989).
3. Employment size - The study businesses employed 1-250 people, with a spread of business sizes to avoid focusing only on very small firms or high-growth companies.
4. Business location - The businesses studied were located in Germany or in the United States. This again allowed the exploration of a variety of business model evolution paths, but within a small range of environmental settings (Eisenhardt, 1989).
5. Business maturity – The businesses needed to be established in the market and have progressed to the market exploitation phase.

A total of 50 cases met these eligibility criteria. Fifteen of these case studies originated from written project reports from start-ups which took part in spin-off support programs at our university, 13 from journal articles, ten from published books or book chapters, five appeared in working papers, five were teaching cases and two were extracted from doctoral dissertations. For the 15 cases from our spin-off support program, we had access to written project reports, business plans, and meeting minutes as well as direct contact to the founders. For the 35 external cases, additional information and data were gathered from openly available sources.

4.2 CODING AND DATA ANALYSIS

To structure the case information, we developed a robust coding protocol based on the conceptual framework presented in the previous section. The descriptive codes were generated from the four categories – transaction content, transaction structure, transaction governance, and relationships – coupled with new themes that emerged from the data. We used four coders to analyze the cases to ensure reliability (Larsson, 1993; Yin and Heald, 1975). Each case was assigned at random to two of the four coders. The first step in coding involved reading the material and deciding on the start and end dates of the phases for each individual case.

The coders were in agreement 91 percent regarding the phases. The coders then compared and discussed the phase boundaries which they did not agree on and resolved all differences. It was important that the coders reached agreement at this stage of the coding process to ensure that both coders would use the same material in relation to the three evolution phases. In the second stage, the coders coded the variables for each phase individually. Questions about specific business model components registered 81 percent agreement, with coders mostly disagreeing on transaction governance and relationship variables. At the end of the coding process, any differences in classification were discussed and resolved. Across all variables, the coders were in agreement 86 percent before discussing and resolving the differences. This score is sufficiently high to indicate that the coded data is a reliable representation of the case material.

Once coding was completed, we conducted in-depth case analyses that highlighted the evolution of single components as well as the evolution of each company's business model in general. In addition, we applied pattern matching and cross-case synthesis to our case set. Within these comparisons, the relevant parameters of the business models under observation were, the number of actor elements, their types (e.g. supplier; intermediary; customer), and their instances (e.g. customer group A in contrast to customer group B; supply firm X vs. firm Y). Further, the topology of the model was examined. In phase transitions, we tried to find similarities, or even equalities, in the way business models of two firms changed between two of the phases. Even if no change occurred in any given element, the non-change was relevant as well, given that both action and inaction in a certain matter may be the result of a deliberate decision.

For recording the complexity of the business models, we designed a measure based on approaches mostly originating from mathematical graph theory and software development methodology (McCabe, 1976; Hall and Preiser, 1984) as well as network science (Bonchev and Buck, 2005). Our business model concept does lend itself to representation in a form similar to that of a graph, with nodes and edges made up of the sub-elements identified in table 1. One example for a complexity measure is the cyclomatic complexity (McCabe, 1976) giving, intuitively speaking, the minimum number of paths that the control flow can take

through a software program. It is computed for a graph *G* depicting this software program with *n* nodes, *e* edges and *p* connected components as $v(G) = e - n + p$ (where the number of connected components is 1 for a single, closed graph, as in our case). Since our business model representation does not depict control flow, but rather the four elements of the business model, the cyclomatic complexity is not meaningful for this case. We therefore selected the sum of the number of nodes and edges in the business model "graph", $c(G) = e + n$, as a measure of the complexity of the business model. This takes into account that each node depicts an actor or parameter, and each edge a relationship between them, each of which requires some kind of active management by the entrepreneur. We computed this number for each case in all three phases.

After the analysis, a single case study was written for each enterprise, in order to summarize the collected data from different sources and especially the entrepreneurs' personal opinions, considerations, and feedback. The names of the companies have been disguised for reasons of confidentiality.

5. RESULTS

We were able to analyze fifty longitudinal case descriptions involving business model characterizations from 31 companies founded and located in the USA and 19 in Germany. The sample includes ventures from six different industry sectors: information technology (n=14), retail (n=9), medicine (n=5), business and professional services (n=7), engineering (n=10), and logistics (n=5).

We identified two fundamentally different types of patterns in the cases: patterns of structure and patterns of development. *Patterns of structure* show similarities that occur in sub-areas of business models of multiple firms at a specific point in time. They generally consist of a number of actors and the relations between them, where the types of actors and the topological structure are similar or equal across different business models.

Since observations from our cases suggested that business models change continuously, the present study focuses on *patterns of development*. The scope of examination here is the whole business model of a single firm and its evolution over

time, in all dimensions: number, type and instance of elements, and topology. In the following sections, we describe the patterns of development we identified in detail and give examples for the occurrence of these patterns from our sample of cases.

5.1 Patterns of Development

Within our sample of cases, we have specified three basic types of development patterns used by the firms we studied: *scale pattern*, *scope pattern*, and *re-emerging pattern*. Within our sample, we identified 17 cases that can be characterized as developing through time with a scale pattern, 24 with a scope pattern and 9 with a re-emerging pattern.

Scale pattern – Companies that use scale patterns aim to maximize the returns from their existing operating logic. They exploit the potential of their current business model in order to grow and profit. Of all the identified patterns, it represents the least actual change: the topology as well as type of actors (elements) stay the same; the only parameter that may be modified is the number or instantiation of elements. This might take the form of an anticipated growth in the existing customer base, or the increase in number or substitution of suppliers of the same type, but there are no sustained changes in the business model in operation and the network itself.

> *Example case: Petrol Lamp Vendor* – This firm had been operating in Germany as retailer and wholesale distributor of petrol lamps since 2005 and had successfully established itself in a market niche, with one employee. The two founders were in a situation where expansion was both possible and necessary to enable further growth. The business model at this point was straightforward: the firm operated mainly as a trader, buying goods wholesale goods from overseas manufacturers and selling them to customers in Germany, mainly through their own website, with part of the sales going to resellers. On the supplier side, the overseas manufacturer of the firm's flagship product is the most important relationship; suppliers of

> other products and parts only play a limited part. Consumers were a well-defined group and the firm had the necessary knowledge to reach them and sell to them. All relationships were basic goods-vs.-money flows. The firm's competitive advantage lay in their capability to manage these flows and their knowledge of their customers, in short, in the proper execution of a trading and sales operation.
>
> This capability was valuable for further development. The business model realization was amplified in two directions. The first was to diversify the product range: the firm improved the branding of the flagship product and introduced a derivative product. This did not require significant changes to the business model itself. On the customer side, marketing activities had to be adjusted to new, additional consumer groups, while on the supplier side a new manufacturer had to be found for the new product. Therefore, the number of partners in the business model increased, but its actual structure did not change – the firm could utilize their existing competencies. The second direction expanded the market scope to include international markets. Like in the first direction, this mainly required a "more-of-the-same" approach in marketing and sales, and allowed the firm to leverage the experience gained in these areas until this point in time.

In this case, the entrepreneurs changed only the *transaction structure*: additional consumers and marketing and rebranding activities, new manufacturers, and new geographical markets. The *transaction content* – petrol lamps and the associated trading knowledge – stayed the same, just as *transaction governance* – the legal and functional form of the firm as a trader – and the *relationships* to the other actors, such as the trust between, for example, suppliers or banks and the firm.

Scope pattern – Start-ups expand their venture's "footprint" to cover new ground – including new markets, value chain functions, and product and service lines to add to existing operations. Scope patterns are frequently observed when start-ups are involved in forward or backward integration, which results in new definitions of customers and consumers, additional core competencies and resources, as well as

new governance and relationship patterns. Again, the model's topology remains largely constant, while some elements change type: especially between “external” and “internal”; or instantiation: replacing certain partners with others due to size, qualifications or location.

> *Example case: Commercial provider of teleconsultations for acute neurology patients.* A leading international neurologist founded the first commercial provider of teleconsultations for acute neurology patients, CPT. CPT focuses on hospitals aspiring to the status “on call” for neurological patients, which encompasses most medium-sized and large hospitals in the United States. CPT started from a very low base – two physicians serving a couple of regional small primary care hospitals, and a 24-7 shift of call center agents located within a big call center handling the inquires. At CPT, a small primary care hospital reaches a call center, which then contacts a suitable neurologist who in turn calls back to the inquiring hospital and arranges the consultation from any location. This call center set-up allowed CPT to follow a globally scalable approach from the beginning so that the best stroke experts can treat patients wherever help is needed.
>
> Having this infrastructure – including a technical solution that can easily handle new hospitals, an outstanding network of teleconsultants, who mostly work part-time for CPT, receive a high hourly rate and assure the quality of service, as well as a payment system that makes the service feasible for different hospital types – CPT was able to expand easily in a number of ways. Today, with 30 neurological consultants spread all over the country, CPT serves the biggest network of spoke clinics worldwide and offers around 1,000 consultations per month to 100 hospitals. While CPT in their first years focused mainly on expansion in terms of the number of connected hospitals and states to reach a positive cash-flow, it now also started offering additional services like relocation or night-shift management to become more attractive to more hospitals and will

> soon expand to other medical indications like psychiatry. In order to better handle and control this diversified expansion and be more in charge of their operations, CPT decided to insource the call center.

This start-up changed two out of the four aspects from the framework: *transaction structure* and *transaction governance*. The first aspect here mainly concerns the numerical expansion of the firm's customer base, while the second is reflected in the conversion of the call center from an external, bought-in service to an internal, integral part of the firm.

Re-emerging pattern – The re-emerging pattern provides a company with a new business model. The company moves deliberately and purposefully to a new value-creating model. In this kind of pattern, the business model topology goes through significant modifications. This obviously also results in changes to the number, type and instantiations of the other elements. However, there usually is a core of elements that remains static and describes the firm's core competency.

> *Example case: Cross-media entertainment technology developer* – An example for this pattern is a cross-media entertainment firm, which based their market idea on the development of a technology for creating entertainment products consisting of an innovative mixture of an audio book and a mobile game, usable on devices like smartphones and MP3 players. At first, the founders saw their business model as representing a pure technology provider to publishers, mobile network providers, and phone and device manufacturers. These entities, after licensing the technology from the firm, would handle content production, marketing, sales, distribution, and the complete consumer experience. This was a very simple business model, with only a few large customers, each expected to generate large revenues in licensing fees.
>
> Realizing that this model would put the firm at the very start of the value chain in this market, with little potential to capture much value and at the mercy of customers much larger than their own firm,

> the founders fundamentally redesigned their model. They positioned their firm closer to the consumer of their product: the user of the entertainment product. Development of an authoring tool enabled them to move content production into their own sphere of influence, becoming a "content production enabler". For the business model, this meant an increase in complexity, since a large number of production partners became necessary, which has to be reassembled for each new product. These would usually be small firms or even independent artists providing commodity services, so that this model requires a higher management effort, but leaves the firm in a position of control with no threats to its central role in the business model. The monetization approach changed as well, since now consumers of the product were also customers of the firm – meaning that there would now be a large number of customers in contrast to only a few, with the corresponding changes necessary in marketing and sales. The only parts of the business model that remained unchanged were the central, technology-based co-operations with research institutes and technology partners.

This case illustrates that in the re-emerging pattern, all aspects from the business model framework are changed. The product itself is modified considerably: this is *transaction content*. At the same time, the founders rethink their complete value chain – *transaction structure* – and, coinciding with this, the revenue system – *transaction governance*. The firm's *relationships* to other actors in their field change accordingly; which leads to an increase in relative power in the new business model.

Table 2 gives an overview of the three patterns of development described above. The scale pattern keeps the topology and changes only the number and possibly instantiation of actors. The scope pattern demonstrates the inclusion of actors into the firm's control which is typical for this pattern. In the re-emerging pattern, the most obvious change is in the model topology, while some actors may also change.

	Scale pattern	Scope pattern	Re-emerging pattern
Degree of change	Low	Medium	High
Aim	Exploitation	Exploration	Renewal
Business model components that are subject to change	Transaction structure	Transaction structure	Transaction structure
		Transaction governance	Transaction governance
			Transaction content
			Relationship
Business model parameters that are subject to change	Number of elements	Instantiation of elements	Business model topology
		Type of elements	

Table 2: Attributes of development patterns

5.2 COMPLEXITY CURVE

By looking only at the development of the number of elements across the time stamps defined by the borders of the three phases, we were able to derive another interesting pattern – the *complexity curve* (see fig. 1). This pattern, which occurred in 31 cases, is characterized by the following progression. The first version of the business model, in the opportunity realization phase, is usually quite simple. Typically, the number of actors in the business model is low – only the principal actors have been identified, such as suppliers of key materials and the main, but still untested, customer group. The next version then tends to become very complex. Frequently, it contains multiple business models at once that in principle would work on their own and could therefore be separated. The following step then leads back to simplification. In the final phase, when the firm moves to exploit the identified market, only small modifications are necessary, if at all.

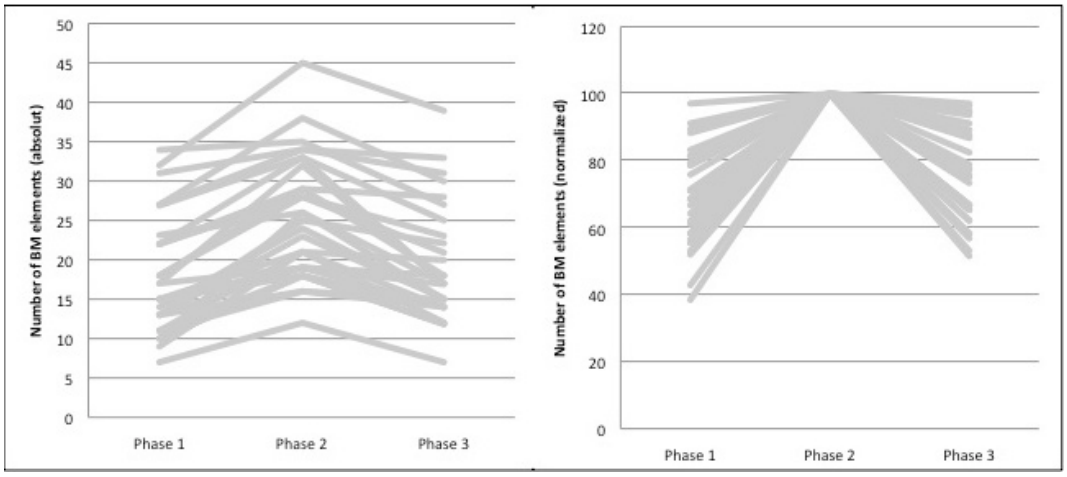

Figure 1: Complexity curve (left with absolute data and right with normalized data)

Example case: Developer of mixed-reality games for mobile phones – This firm developed a game system for mobile phones that allows players to interact in the real world, with the phones used as game tools and connected by the Internet to the firm's servers. In the beginning, the plan was simply to sell the game software, ideally over the so-called app stores introduced at that time by mobile phone manufacturers and network operators. This business model had the advantage of being well tested – there are many software firms that earn money by selling software to end customers. In addition, this model would be simple enough to let the founders concentrate on their core strengths of writing software and developing new games – they would not need to put a lot of effort into running and building their company. Unfortunately, preliminary market research and observed experience of similar firms in the mobile software business showed that it was very difficult to become profitable as a pure software company in this market for a variety of reasons. The founders therefore started to look for other business models that might offer a better chance of earning revenues and final success.

They came up at first with a large number of revenue models: merchandising of clothing, customization for enterprise customers, run-

> ning game events, location-based ad support of their software, a virtual currency for buying in-game accessories, pay-for-play, a subscription model – it all looked good and doable. After going from revenue to business model and identification of the necessary partners, it became clear that these ideas would result in different and quite distinct business models. An attempt to integrate all models led to the realization that this would be too complex to run and manage for a start-up that still had only a handful of employees. After analyzing the value creation potential of the separate business models, the firm again concentrated on developing game software for sale in app stores – this model had become much more attractive in particular by the introduction and success of Apple's iPhone and its App Store ecosystem, and for this specific firm due to the unavailability of investor funding for faster growth. Parts of the other business models were not discarded, but received a place in the firm's planned organic growth path.

The complexity curve records first the founders' learning about the intricacies of their project, as well as increasing availability of data, and therefore contains every little detail in the second stage. Continued experimentation, learning and recognition of difficulties with part of the model, as well as judgments about the relative importance of detail lead back to simplification. Coinciding with the complexity curve is the successive discovery of layers of important but non-obvious actors, which need to be accommodated in the model, as well as redundant elements, which need elimination.

6. DISCUSSION

Several authors have discussed reasons for and the importance of business model change for early stage ventures but to the best of our knowledge, there is no empirical analysis of patterns describing how business models change over time. By analyzing our fifty cases we were able to show how the number, type, instance of elements and topology of a venture's business model alter between opportunity recognition and market exploitation. We call this comprehensive observed change

business model metamorphosis.

We found that business model metamorphosis was taking place in all entrepreneurial firms examined. This change had rather different forms: it ranged from simply adding a new distribution channel to switching to a new product in a new value chain position – or, in business model terms, from changing just a single feature of the business model to total reinvention and reorganization. Change takes center stage in entrepreneurship and should therefore be considered from different angles.

6.1 ENTREPRENEURS AND CHANGE: EXPERIMENTATION AND LEARNING

The complexity curve reveals an important characteristic of how companies progress through the three proposed stages. Firms – or rather entrepreneurs – undergo an important learning process while gathering, ordering, and processing information about the firm itself (micro level), its suppliers, customers, and partners as well as the relationships and network structure (macro level).

In the venture creation stage, founders passionately realize their vision in the shape of establishing their new company by believing in the potential of their business idea, creating mental business models and planning actions needed to start a new venture. They have to decide how to configure all business model elements. Sosna et al. (2010) state that this phase is characterized by trial-and-error learning. Experimenting with different alternatives in a trial-and-error approach would be impossible without the analytical skills and engagement of founders. Similarly in a later stage, the individual is the driving force behind applying scale, scope or re-emerging pattern on an existing business model even though the firm has grown bigger in the meantime (i.e. employing more people). It should be added that even though change can be triggered by external events (Sosna et al., 2010), it is always the action of individuals that determines which course of action to follow.

The bounded rationality of individuals regarding change is among the most important aspects to consider when considering business model evolution. Tripas and Gavetti (2000) argue that cognitive representation of the world forms the ba-

sis of humans' mental models and the beliefs that impact their decisions and actions. Since it is difficult to change the initial choices imprinted in the founders' mental models (Hannan and Baron, 2002), companies have a tendency to fit emerging 'circumstances' into their current business model independent of the fact if this is the best configuration. This calls for the enhancement of the existing business model tools we provide entrepreneurs with so they can support the entrepreneur in finding the optimal mutual fit.

6.2 The Business Model as a trial-and-error tool

The entrepreneur does not need to make one single, grand plan and be correct in every aspect of his plan right from the beginning if the business model can support a trial-and-error process. Then, 'tinkering' could be a natural method for handling and using the business model as an exploration tool. To be useful, this process of trial and error can be performed on relatively small subsets of the business model at a time. This approach can take two forms. One is an abstract, cognitive approach, using the business model in a predictive role, that is, as a model in the true sense: explicit, possibly conflicting, changes are made to the business model, and the consequences are evaluated. This requires access to necessary data, and results in outcomes that can be judged in terms of their probability, but are not assured. The other experimental learning approach operates on the 'living patient' itself: changes are made in the real firm, and results have to be accepted as they develop. Entrepreneurs and start-ups would benefit from a mix of both approaches – cognitive and action-based – since it would allow them to better understand and experience the opportunities and challenges involved in each type of business model change. This intertwined approach also corresponds to the call within the bounded-rationality literature to use the analytic and experimental learning perspectives jointly (Gavetti and Levinthal, 2001).

6.3 The Design of Change

The trial-and-error process of business model learning and experimentation can even be taken a distinct step further. In the context of a fast-changing environment and complex change decisions, individuals need tools to structure their thoughts.

This is especially true for business model change in early stage companies since so much information is vague and action paths are undetermined. The business model cannot only help to adjust and get an overview of the status quo but it can also be used in a proactive way to design change. Including this design perspective could bring several advantages. First, design as an evolving process serves to integrate individuals, share knowledge, expectations, and concerns. In this sense it might open up entrepreneurs to share ideas and understandings with their team and network partners and thus generate novel ideas as well as efficient, new collaborations. Second, the design process can help to obtain an overall view of the value creation and capture logic of the firm and thus helps the entrepreneur constantly to co-create the cognitive understanding whenever day-to-day business gains ascendancy. Last, design demands creativity in imaging the future in terms of alternative possibilities. This makes it possible for founders and their teams to act as observers on the one side but also proactive creators by taking the lead in change initiatives.

6.4 Methodological Issues - From Change To Dynamics

In our analysis, we differentiated between three phases for firm development: opportunity recognition, market entry, and market exploitation. This was necessary to set timestamps and enable the comparison of the case data. Nevertheless, the coding process and our data showed that well-defined, pure stages do not exist. Companies used feedback loops at different stages with different impacts, and transitions from one phase to another were anything but linear. We would therefore emphasize Levie's and Lichtenstein's (2010) call for a "dynamic state" which is a network of beliefs, relationships, systems, and structures that converts the tension between the fundamental opportunity and the entrepreneur's perception of the opportunity landscape into tangible value for consumers and customers, generating new business model structures that maintain the dynamic state. We would suggest taking this finding into consideration in further research on business model dynamics. It remains open how to operationalize longitudinal analysis applying the concept of a dynamic state.

In summary, we can say that business model metamorphosis is an important and crucial aspect in early stage ventures. There are a lot of open questions remaining, especially regarding the measurement of change and its impact on firm success. However, business models can act as agents mediating between value creation and value capture, confirming the great potential and relevance of the concept for scholars and practitioners alike.

7. IMPLICATIONS

The business model concept – as a construct that helps to coordinate start-up activities and to cope with complexity and uncertainty – plays an increasingly important role in the entrepreneurship literature. We expanded the concept by introducing the idea of business model metamorphosis in order to capture the processes occurring, and structures developing, during venture creation and growth. The discovery and systematic treatment of business model dynamics patterns allow deeper insight into these processes and structures. This new field of research offers a number of important implications, both for practice and for further research.

7.1 IMPLICATIONS FOR PRACTICE

This paper is, by design, theoretically orientated and intended to generate new directions for further research. Nevertheless, the findings on business model metamorphosis lead to several implications for entrepreneurial practice, including entrepreneurs themselves, educators, and policy makers in the area of entrepreneurship support.

The most obvious observation for *entrepreneurial practice* is that the process of working with the business model could be of great value for entrepreneurs. Planning the development of the venture, the business model gives them room to sort the available alternative paths for opportunity and market exploitation. The business model helps to understand the interrelations of network partners and activities. Furthermore, explicit thought about the business model can be the key to installing patterns suitable for different development paths. Since start-ups progress through different stages in which specific growth and market opportunities, as well as challenges and demands, must be addressed through the use of adequate

skills and appropriate, i.e. changing, business model structures, we suggest the implementation of business model design in the venture creation and early venture phase.

In *entrepreneurship education*, business modeling is a good vehicle for translating a creative idea or recognized opportunity into a real business concept. Given the time constraints imposed by most course programs, identifying an original idea for a business, performing the necessary research and finally developing a full-fledged business plan within a typically available time span (e.g. a semester) can be quite difficult, and often requires a lot of ancillary work by students that is not strictly useful for understanding the central ideas of the entrepreneurial process. Teaching business model-based entrepreneurship also allows much better illustration of the importance of change and development. It is much easier to demonstrate and discuss these topics using the business model than it would be to discuss changes between multiple versions of a business plan. The business model is a practical alternative that offers all participants to learn about the integrative, inter-disciplinary and dynamic nature of entrepreneurship, as the key is mostly how decisions are combined.

Policymakers would be able to give valuable support to would-be entrepreneurs by setting up programs to improve their networking abilities, both on the personal level (e.g., providing training) as well as on the institutional level (e.g., organizing fairs, connecting firms).

7.2 IMPLICATIONS FOR RESEARCH

This paper and its underlying approach have several particular strengths and limitations. First, the results cannot be assumed to be typical of all businesses. They may be constrained by location, industry, and peculiarities of the time of examination. Second, as with any research that relies on previous developed cases, our findings are constrained by the quality of the original case descriptions (Yin and Heald, 1975). Third, especially business cases that were prepared for educational purposes may be oversimplified, ignoring the complexity of the business models involved. However, a positive effect of this oversimplification may be that the

relevant issues are made more explicit. We tried to eliminate this limitation through data triangulation and controlling the data within the cases as far as we could. Fourth, because data collection always involves the risk of interpretation and bias, using existing cases from different authors reduces risk of personal bias. Future research may be improved by validating the coding results with stakeholders from the firms involved (Larsson, 1993). Finally, although we instructed our coders to limit themselves to the information contained in the given data, we often found that common sense and common knowledge would dictate that certain business model components are actually changing, even though that was not mentioned explicitly in the material.

Our findings offer a starting point for research on business model dynamics. They are based on the examination of the cases compiled for this study. Testing and refining against a larger data set is desirable. Data sets for this purpose can only be built over time, ideally with longitudinal studies. Nevertheless, the present study opens interesting opportunities for further research in four major directions.

First, additional research is required on what the underlying logic is to choose one business model development pattern over another. Effectuation theory suggests that entrepreneurs focus primarily on the resource under their control, and then develop their new ventures in an iterative way (Sarasvathy, 2001). In contrast to the effectual logic, a causational logic starts with a specific goal and then focuses on selecting the resources needed to achieve those goals. Relatively little empirical research has looked at the conditions under which an entrepreneur will use either causation or effectuation logic in the new venture formation process, or whether both logics are used at the same time (Sarasvathy, 2003). Research in this area could determine attributes that influence the entrepreneur's choice of one business model development pattern over another given common underlying market or technology uncertainties.

Second, insight into the dynamics of the links between external events and the configuration of internal value system components is highly relevant for practitioners in order to keep their business models adaptable and flexible over time. Especially, the alignment with technology developments – which is one of the

most important reasons for business model adaptation over time (MacInnes, 2005) – needs closer examination.

Third, further research is needed on generic "design themes" for business models. The design literature presents concepts such as design architectures and dominant design (Baldwin and Clark, 2006) that could help to identify business model elements that are reinforcing in nature or that determine the prerequisites for other business model elements. Identifying such reinforcing or defining business model elements would enable researchers to discover generic typologies for business models. It would be especially worthwhile to look for patterns that are specific to high-growth ventures and describe their value creation leverage, and thus their underlying growth mechanisms. Going hand in hand with this would be the development of a business model design tool that incorporates the explored structural patterns and supports the entrepreneur as well as entrepreneurship educators in the process of business model analysis, design and reconfiguration.

Finally, the complexity curve calls for additional research on the "network fit". It could be assumed that one important result of ensuring the network fit is the reduction of transaction costs. This directly influences the firm's performance, provided it is able to capture the generated value. Another benefit is easier adaptation of the business model in the next phase of the firm's development, since the model does not contain any superfluous elements. As a consequence, firms that complete this process in fewer phases can gain these benefits earlier, therefore achieving higher performance. However, it remains unanswered how entrepreneurs as designers, builders, and controllers of networks, relationships and resources can assess the fit of their business model components and thus how they can determine the efficiency of the generated network.

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PAPER 3

Beyond high tech: the pivotal role of technology in start-up business model design

Franziska Günzel & Helge Wilker

Abstract

Technology plays an important role for any start-up – as an opportunity to be exploited, as well as an enabler to structure the start-up's activities to better generate value. The business model is a useful tool in these settings to keep track of technology and understand its potential value for the start-up. To analyse the interrelation between business model development and technology change, a multiple case study approach was conducted. Using a maximum variation strategy, three cases of start-ups depicting the range of technological discontinuity were selected. Analysis of these resulted in three different ways in which technology use in new ventures influenced business model development and vice versa. In addition, this paper introduces the business model dynamics framework as a tool for pro-active, continuous business modelling and analysis.

Keywords: business model, business model dynamics framework, BMDF, multiple case study, change, design, dynamics, entrepreneurship, start-up, technology, venture creation process, value

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1. INTRODUCTION

The first step in any entrepreneurial activity is opportunity recognition (Shane and Venkataraman, 2000; Fayolle, 2007). Observing a number of new entrepreneurial ventures in different start-up support programmes, it is noticed that entrepreneurs often struggle with the next step: creating from scratch – and maintaining – a strategy for their new firm.

Until now most research focuses exclusively on technology-based start-ups. These ventures often make the mistake of losing sight of the primary purpose of any commercial venture: delivering value to the customer (Chesbrough and Rosenbloom, 2002). Instead, technology and technological development for their own sake take centre stage, driving out recognition and consideration of all other factors contributing to the primary purpose – such as customers, suppliers, end users, regulatory context, quality, or finance (Hamel, 2000).

A different type of opportunity is more subtle for start-ups. Technology cannot only be a value generator in itself but also enables firms to structure and organise some or all parts of their activities in such a way as to better generate value (e.g., Orlikowski, 2000). This more implicit use of technology can take the form of an extended product range, shortened delivery times, higher quality, better discrimination of customer segments, and many other gains that are not easily visible from the outside. This type of venture may fail to keep track of further developments in technology that might offer firms competitive advantages.

Since the potential value of these opportunities depends strongly on the environment, or ‘state of the real world’, at the moment an entrepreneur tries to exploit them, it is central to entrepreneurial success to keep track of changes in the factors that describe the venture’s environment (Shane and Venkataraman, 2000). More generally, recognising the full potential provided by all types of opportunity is helped by a comprehensive overview of these factors as well as the current value-generating activities of the venture. A tool that enables value identification and quantification for all types of opportunities and facilitates change during all stages of venture design contributes greatly to the success of a start-up: this tool is the

business model (Morris et al., 2005; George and Bock, 2011).

Business models, cannot be static if they are supposed to enable start-up success, but have to be revised over time and adapted to remain fit with changing technology, market, and regulatory conditions (de Reuver et al., 2009; Günzel and Wilker, 2009). Design choices made at a point in time during planning of initial service and underlying technology typically change during subsequent stages of market entry and commercial exploitation, based on new information gained from these processes. The alignment of developments in technology, on the one hand, and in the business model, on the other, – with technology being one of the most important reasons for business model adaptation over time (de Reuver et al., 2009) – warrants closer examination. Additionally, insight into the dynamics of the links between external events and the configuration of internal value system components is highly relevant for practitioners in order to keep their business models adaptable and flexible over time. This holds for both entrepreneurial as well as managerial practice.

This paper aims to contribute to the understanding of the interrelationship of technology and change by using a multiple case study approach. The analysis of three start-up cases offers in-depth insights into the linkages between technological change and business model adaptation and illustrates the use of a new tool for business modelling and analysing: the business model dynamics framework (BMDF). Thereby, the paper makes three important contributions. First, we offer detailed descriptions of the linkages between technology and entrepreneurial activity for low to high-tech start-up companies. Second, we suggest a framework for business model design and analysis. Third, we identify several practical implications of our findings for entrepreneurs and start-up support programmes.

2. LITERATURE REVIEW

As this contribution aims to explore the mechanisms and links between external technology change and business model adaptation, as well as internal technology development and business model enhancement in the start-up stage, the literature review in this section first briefly introduces the business model concept in the

entrepreneurship context and the links so far explored between technology and business model design. Subsequently, tools to design and analyse the business model and its change are reviewed.

2.1 THE BUSINESS MODEL CONCEPT IN ENTREPRENEURSHIP RESEARCH

In venture creation, some authors view having a clearly articulated business model as early as possible as essential, since it is meant to be the central construct to coordinate start-up activities and consequently the basis to cope with complexity and uncertainty (Barringer and Ireland, 2007; Sandberg, 2002). This is one reason why the business model receives more emphasis in recent entrepreneurship literature (e.g., Morris et al., 2005; George and Bock, 2011). But there is still much confusion about what a business model exactly is, how it can be usefully applied, and how it can be distinguished from established organisational constructs such as strategy. Thus, the interpretations of the term are quite diverse in the field of entrepreneurship. The business model is described as a facilitative intermediary in the opportunity creation process (Amit and Zott, 2001), as the link between innovation and value creation (Chesbrough and Rosenbloom, 2002) as well as the cognitive link between entrepreneurial appraisal of the opportunity and its exploitation (Fiet and Patel, 2008). Other authors equated it to the underlying 'business idea' or the firm's value creation mechanism (Afuah and Tucci, 2003; Markides, 2008).

With a few exceptions (Andries and Debackere, 2006; MacInnes, 2005; Vaccaro and Cohn, 2004), most literature has taken a static perspective on business models, implicitly assuming them to remain stable over time. While reasons for business model adaptation are researched widely, the process and structure of how start-ups change their business model has not been addressed yet. In a previous study (Günzel and Wilker, 2009), we analysed the development of business models from opportunity realisation to market exploitation. To our knowledge, these results are the first empirical insights into the business model development process of start-ups. The study finds initially that all observed start-up's business models changed and, thus, change is an important aspect in the venture creation process and needs to be integrated in the business model design. Second, it depicts

the importance to analyse the effect of technology change on business model development and vice versa, with technology being one of the most important reasons for business model adaptation over time [see also de Reuver et al. (2009)]. Besides this study, literature on business model innovation – with innovation lying at the heart of entrepreneurship – gives first directions for this research area.

2.2 BUSINESS MODEL INNOVATION

There are two generally separated but interrelated streams in the exiting literature on business model innovation: business models to capture value from technology innovation and business models as innovation forms (Teece, 2010).

Many studies in the former area assess the business model as a construct that mediates the value creation process – it translates between the technical and the economic domains, selecting and filtering technologies, and packaging them into particular configurations to be offered to a chosen target market (Chesbrough, 2004; Chesbrough, 2006; Chesbrough and Rosenbloom, 2002; Doganova and Eyquem-Renault, 2009; Teece, 2010). This perspective frames business models within an innovation context, defining it as "a coherent framework that takes technological characteristics and potentials as inputs and converts them through customers and markets into economic outputs" (Chesbrough and Rosenbloom, (2002), p.532). Moreover, the business model acts to ensure that the technological core of the innovation delivers value to the customer.

The latter research stream argues that business model innovation does not rely on breakthrough technologies or product launches (Santos et al., 2009). Here, a business model is a component of innovation commercialisation separate from product and process innovation. This adds a new source of innovation to Schumpeter's typology (Zott and Amit, 2002). The business model may not serve only to exploit an opportunity for value creation, but its design may be part of the opportunity development process in and of itself. Thereby, in fact, the design of a new business model strikes at the core of entrepreneurship (McGrath and MacMillan, 2000; Hitt et al., 2001). The entrepreneur can co-create opportunities by designing novel business models and may complement innovation in products and services,

methods of production, distribution or marketing, and markets.

There are only a few methodological tools and frameworks developed to support business model innovation and development, unlike the highly developed ones for classic competitive situations. An adaptive framework for innovation suggests that business models adjust in parallel to the firm's life cycle evolution (Andries and Debackere, 2006). Business model innovation at the firm level would then be especially prevalent among immature firms in capital-intensive and high-velocity sectors. Voelpel et al. (2004) developed a four-dimensional tool of business reinvention, which makes sense of environmental changes and the relevance of a possible new business model. Mahadevan (2000) proposed a framework for business model innovation and suggested that incumbent firms and start-ups differ vastly in their approach towards business model innovation. It remains unclear, however, how entrepreneurs can design a new (innovative) business model and thus how they can capture value from technological innovation. Hands-on approaches are needed to support entrepreneurs to solve their problems.

The same holds true for the proposed business model concepts in current literature (Boulton et al., 2000; Deelmann and Loos, 2003; Deelmann and Loos, 2004; Gordjin and Akkermans, 2001; Osterwalder and Pigneur, 2009; Weill and Vitale, 2001; Wirtz, 2001). They are either too complex to be usefully applied as a practical tool for proactive planning in entrepreneurship, or they are only applicable ex post, when all required information is easily available, delivering a static description at a single point in time of the development of what, at the time of analysis, most often is an ex-start-up. Another lack in existing conceptualisations of business models is the strongly interconnected nature of the elements. The business model conceptualisations do outline some links, but these concepts do not give a systemic picture on what decisions will lead to what outcomes and, more specifically, the dynamical nature of changes between different elements in the models. Therefore, the existing concepts can only be used as starting points in building a new entrepreneurship-focused approach. The results of this research present promising directions for re-conceptualising the business model along these lines.

3. CONCEPTUAL FRAMEWORK

Since there are very few studies on business models that account for business model evolution, we cannot rely on existing research approaches. Several scholars call for incorporation of macro (network or environment) and micro (firm or internal) level considerations in new entrepreneurship research to better understand its phenomenon and the underlying processes (Davidsson and Wiklund, 2001; Steyaert and Katz, 2004). Even with the tremendous expansion of the field, most entrepreneurship research still either focuses on the micro level and draws conclusions about macro outcomes, or begins with the macro level and infers specific entrepreneurial behaviours. This either-or approach is problematic for the analysis of business models, because sources of value creation and capture that influence the start-up and its development are found at both levels (Morris et al., 2005). Therefore, what is required is a business model approach that covers micro and macro level aspects, taking account of both the firm level and the network level in combination without favouring either one.

The existing literature provides several diverging definition attempts, resulting in a certain amount of confusion. Therefore, a new approach to thinking about business models and business model dynamics is necessary. We base our research approach on the following entrepreneurship-centric definition:

> *"The business model is the configuration of transaction structure, content and governance as well as the organizational and personal network structure that describes how value is created and captured in order to act upon and exploit business opportunities."*

In this view, the network structure consists of the transaction, governance, and relationship structure, thereby embedding the network of managerial relationships within the organisational context. This element has been missing in previous definitions. People, relationships, and networks are as much part of a business model as are resources, technological dependencies and economic exchanges, and thus contribute to the venture's success. Resources and the market offering describe the transaction content, which describes both the goods and the information being

exchanged as well as the resources and capabilities required to enable the exchange.

Based on this definition, we define the BMDF. The framework consists of the business model definition, a graphical language for visualisation, since visualisation helps entrepreneurs as users to understand and communicate their business model (Eppler and Platts, 2009; Seppänen and Mäkinen, 2005), and a set of guidelines for application and analysis. The selection and design of these elements is based on our review of the business model literature, both normative and descriptive, as well as on the analysis of a number of real-life business ventures that we have accompanied during their planning and start-up phases in start-up support programmes at our university. The visualisation method is not covered in this paper, since the subject here is to examine the relationship between technology change and business model development (an introduction to the visualization method can be found in Günzel and Wilker (2011)).

3.1 MODEL COMPONENTS

The framework requires, for our purpose, a way to formalise business model components. Given the above business model definition, answers need to be given to the questions ‘who’, ‘what’, ‘how’, ‘how much’, ‘when’, ‘where’, and ‘why’, providing information about all important parameters for planning a start-up. It is clear that since in some cases the answers to these questions do not make sense or are simply not available, they cannot and do not need to be all answered, at every point in time.

The most visible and accessible elements when thinking about a venture are the *actors* that are involved. Finding the actors answers the ‘who’ question. The first actor to be identified usually is the *start-up* itself. Next in line are *suppliers*, *customers*, and *consumers*. The distinction between customers and consumers is important for several reasons: First, the business opportunity may only be visible in the business model if the consumer, not just the customer, is taken into account. Second, a firm often has direct contact only with its customers, while the actual consumers are removed from direct contact. This can lead to misunderstandings

regarding customer and consumer preferences about the value proposition of the product or service. Third, while a customer might often simply exchange a product for money, there are many cases in which the connections are more complex and involve a network of multiple actors connected in a non-linear way. *Partners* mostly are some kind of service provider or enabler necessary for creating the value proposition inherent in the venture's offering (e.g., advertisers, consultants, reviewers, licensors, universities). The final distinct class of actors are *regulators* (e.g., legislatures, state agencies or standards bodies) that can exert some kind of influence on the venture. All ventures are characterised by their *capabilities* and *resources* that are required to provide the offering and enable the execution of its envisaged business model processes.

As a further step in detailing, an actor is modelled as a combination of *entity* (or identity) and *role*. Actor entities can be single persons, other companies or organisations, or collections of these. Splitting the meaning of the actor element in two allows single entities to assume multiple roles in the same business model. This is important because different roles for a single entity may mean different and possibly contradicting preferences on the side of a supposedly monolithic actor, which in turn influences this actor's behaviour.

Decisions about which actors to include and which to exclude, in other words about the boundaries of a business model, can be taken by answering the 'why' question or, more completely: "Why does this actor, in this role, act in this way?" The selection decision, then, is based on whether the actor generates value – both for the venture, leading to his inclusion into the business model, but also for himself, providing his motivation. For this, it is important to distinguish between the actor's identity and his role, because motivation is based only on role, not on identity.

Since the venture's network is an integral part of the business model, representing the *relationships* between actors – who are the main providers and controllers of the resources – is an important part of the business modelling process. These relationships also depend on the nature of social networks and the quality of relationships among the individuals engaged in the exchange. Relationships can be

classified into social, political, and interpersonal dimensions. We model them in two forms: *flows*, describing the content of transactions, and *influences*, describing their governance.

Flows depict the transfer of a good, service, information, attention, or money from one actor to another. A flow always has a direction, and a dimension (size and unit of measure), thus answering the 'how much' question. Existence of a flow-type relationship between actors may imply some kind of formal contract or agreement, but this is not necessary. Influence depicts a situation in which one entity reduces or increases the range of options for another entity. 'Entity' in this case can mean both actors and flows – the quantity of a flow can be influenced as well as an actor directly. Examples for influences are laws, licenses, and advertising.

The combination of actors and relations into a network, finally, delivers the 'where'. The relations between actors in the business model determine relative positioning of the actors in the value chain, allowing analysis and interpretation of relative importance which, in turn, can suggest modifications to the model in order to increase the entrepreneur's control of the venture. At this point, the type of the venture according to the canonical classification becomes clear: business-to-business, business-to-customer, etc.

We introduce a dynamic component in order to track the development of the business model over time in reaction to changes in the environment. These changes may take the shape of new information, or new technology, becoming available, or of a different view of the business on the part of the entrepreneur. This is achieved by versioning the changing business models during the venture creation process. In practice, snapshots of the model are taken after significant changes, which can then be compared over time. Comparison of alternative business models during planning (before starting the venture) allows making decisions on these alternatives based on their different value creation potential. The same analysis of the business model evolving over time can show whether the planning process is moving in the direction of increasing the value creation potential.

4. RESEARCH DESIGN AND APPROACH

The goal of this explorative study is to contribute to theory building in the field of entrepreneurship, with emphasis on the relationship between technological change and entrepreneurial activity as well as on the influence of business modelling on enabling and supporting change in the venture creation process. One interesting question here is what role external technology development plays in firms that do not have a product based directly on a new technological development. According to Yin (2002) and Flyvberg (2006), the key factors that underlay the proposed study, such as the complexity of the research topic, the nature of the study, the type of research questions, and the research purpose suggest the use of a qualitative methodological approach, and in particular multiple case studies, which is a preferred method to study a complex social phenomenon deeply embedded within its real-life context (George and Bennett, 2005; Hancock and Algozzine, 2006; Stake, 2005; Yin, 2009). In line with this, Gartner and Birley (2002) regard multiple case study research as an especially useful tool to understand the complex nature of entrepreneurship.

In a related study (Günzel and Wilker, 2009), we assembled a set of fifty longitudinal case descriptions of start-up firms, both in Germany and the USA in six different industry sectors: information technology, retail, medicine, business and professional services, engineering, and logistics. Of these, 15 case descriptions were based on start-ups that took part in one of our university's spin-off support programmes.

In order to address our research questions, we first only looked at the 15 cases from our spin-off support programmes, since our proximity to these local spin-offs over periods of several months enabled us to apply the BMDF while observing the development of the ventures' business models, with continuous reactions and feedback from entrepreneurs themselves. To gain a comprehensive understanding of the researched relationships we applied the maximum variation strategy to select either firms that were not primarily technology-based, but exhibited changes in their business model due to external technology changes over time, as well as firms that were technology-based and in which technology had a strong

influence on the chosen business model. An additional case selection criterion was that the person responsible for technology development in the start-up was willing to cooperate with the data collection and review process required by the case study design.

We selected three cases depicting the range of technological discontinuity as needed. To improve the rigor and reduce misunderstanding data was collected from different relevant sources (Hancock and Algozzine, 2006; Yin, 2009). For all cases, we had access to written project-reports, business plans, meeting minutes as well as direct contact to the founders.

To structure this information, we developed a robust coding protocol based on the BMDF approach. The descriptive codes were generated from our BMDF component categories coupled with new themes that emerged from the data. Once coding was completed, we conducted in-depth case analyses highlighting the relationship between each company's business model and technology, and the reasons for the observed linkages. In addition we applied pattern matching and cross-case synthesis to our case set. A single case study was written for each enterprise, in order to summarise the collected data from different sources and especially the entrepreneurs' personal opinions and considerations. The name of the companies has been disguised for reasons of confidentiality.

5. CASE STUDIES

This section presents the cases that best fit the selection criteria described above. Analysis and interpretation of the cases is the subject of the next section. Table 1 contains basic data on the three cases.

Company	*Industry*	*Year founded*	*Start-up support (months)*	*Sources used*	*Technology discontinuities*
Precious metals trader	Retail	2009	4	Business pan, project report, feedback meetings, open sources	Technology adapting venture
Telemedical stroke care advisory service	Healthcare	2011 (intended)	8	Project proposal, project report, meetings, open sources	Technology advancing venture
Semiconductor wafer manufacturer	Manufacturing	2004	5	Business plan, project report, feedback meetings, open sources	High-tech venture

Table 1: Case study characteristics

CASE 1: PRECIOUS METALS TRADER

The founder of this firm realised that certain segments of the precious metals market were very fragmented. Many people own inherited jewellery and decorative art on which they place no emotional or utilitarian value. The founder saw that since the monetary value of even small amounts of metal is considerable, these people would sell these metal objects if an easy way would be available.

For a number of reasons, this is usually not the case. For most households, this

would be a one-off transaction; therefore, they have no knowledge of market prices and price movements. Such buyers are available, e.g., itinerant traders or backyard dealers, but they are viewed as untrustworthy. Fear of losses from a sale at disadvantageous conditions is great, and the expected gains from a sale are unclear or perceived as not large enough to warrant seeking further information.

This was the situation when starting out: many small-scale households/sellers meet many equally small-scale buyers/traders, which in turn sell accumulated, but still relatively small amounts to large, industrial smelters. Price information from spot markets is not available to sellers, who therefore have an incentive to not put too much trust in the small-scale buyers. In sum, this results in many uncompleted transactions, and many unused, but unsold pieces of jewellery.

The potential value of the sum of these transactions, however, is huge, since there are many households possessing such objects and thus can be considered as potential sellers. The wholesale side of the precious metal trade is a conventional, business-to-business market, with no barriers to access. The founder saw an opportunity for arbitrage in consolidating the large number of these transactions and positioning himself as a middleman between the potential sellers and industrial wholesalers. Analysing the prevailing business model on the market, it becomes obvious that the main barrier to overcome is the lack of trust towards buyers on the side of the sellers.

The founder's firm therefore designed and set up small store-in-store buying modules at established retail locations. These locations are selected for existing trust with customers: jeweller's shops, department stores and other suitable retailers. The buying modules are designed to project transparency: metal prices are looked up in a frequently- updated list instead of being quoted from thin air; scales and appraisal equipment is standardised; every seller receives a printed receipt of the transaction; there is no haggling or negotiation. Sales personnel are trained to perform the buying transaction in an appropriate manner. The firm also raises trust by marketing the service using a single brand. The small amounts of metal gathered at each location are then collected regularly, consolidated into larger batches and forwarded to a wholesale smelter and processor with a mark-up. In order to tap

the full potential of the market, it was still necessary to set up a relatively large number of buying locations so that sellers would have easy access to one. This business model would have been unwieldy, if not impossible to implement in the large scale achieved without cheap and ubiquitous internet communications and computers to keep track of the large number of small, widely distributed transactions which are necessary to generate sufficient profits. It is important to note that in the beginning, the business model was simple, with buyers in the centre performing a classic trading role. There were a lot of market participants but all of them small in size. The new business model envisions bringing a large part – or the whole – of this market under the control of a single firm. The number of actors is still relatively large, and the type of transaction has become more complex: the sellers are in principle paid directly by the firm, while the retailers running the buying modules receive a commission. The provision of the infrastructure itself and the necessity of frequently updating price information at each location is a moderately complex undertaking as well.

Most market activities in this business model were present beforehand – some transactions did take place, with small amounts of metal from private sources ending up in wholesalers' smelters. However, the firm assembled the activities in a new way, configured some of them differently and, importantly, added standardisation to the selling transaction, all in order to draw new sellers into the market. New actors were introduced: the retail locations that before had nothing to do with precious metals, but possessed customers' trust.

CASE 2: TELEMEDICAL STROKE CARE ADVISORY SERVICE

Stroke is a suddenly occurring medical emergency with potentially far-reaching and grave consequences. The window of time for treatment is extremely short – only four and a half hours – and possible long-term effects of the associated brain damage include failures of higher brain functions, of motor control, and loss of memory. Rapid treatment is hampered by the necessity to precisely diagnose the type of stroke in order to select the proper therapy. Requirements for this diagnosis are basically a CT scanner for detailed imaging of the affected brain area, and a specialist physician to interpret the imaging together with the patient's clinical

symptoms (Adams et al., 2007; Hacke et al., 2008; Ringleb et al., 2008). CT scanners are generally available even at smaller hospitals receiving emergency patients. Stroke specialists, however, are rare compared to the availability of CT scanners and stroke cases. Non-specialised physicians can in turn perform the necessary therapy after the diagnosis has been ascertained.

The traditional course of action for a suspected stroke case requires the first responders to transport the patient, if possible, to a hospital with a so-called stroke unit: a unit that maintains the medical equipment, the patient beds, and the specialists required for stroke care on round-the-clock availability. Since strokes happen seldom enough to make it prohibitively expensive to maintain such a stroke unit in each and every hospital, a large part of the treatment time window is often wasted in forwarding patients over considerable distances to the nearest stroke unit. Many stroke cases are not treated at all because a timely diagnosis is not possible; therefore, the cost in terms of patient deaths and deterioration of quality of life for survivors is considerable, and an improvement of the situation would deliver savings in rehabilitation and long-term care.

Analysis of the ‘standard’ business model for stroke care, along with the recognition that the combination of specialised diagnosis technique and simple therapy renders itself well to a technological approach, led the firm in this case to explore a new business model opportunity. The technology is relatively straightforward and not especially new: transmitting CT imagery of a suspected stroke case, along with interactive high- resolution video of the patient, over fast data networks from a suitably-equipped hospital without a stroke unit of its own (a so-called spoke) to a remote stroke unit with corresponding equipment (so-called hub), where a stroke specialist reviews the case and pronounces the diagnosis. Physicians in the satellite clinic then perform treatment and further therapy.

The relatively recent availability of these technological elements – fast data networks between hospitals, combined with high-resolution cameras that can be controlled remotely – enabled the exploitation of this entrepreneurial opportunity by the firm in this case. The founders decided to set up a hub service centre as an independent organisation offering the full spectrum of products and services ne-

cessary for a small hospital to become a spoke, with technology and support for remote image transmission and patient observation, stroke specialists that are on call for teleconsultations 24 hours every day, records and data management and billing. Customers are hospitals without neurological experts, who are billed for services rendered, and who in turn bill their patients or their patients' health insurer. The personnel working in the hub service centre are occupied exclusively with teleconsultations and the support of the service; no patients are treated locally at the hub.

In the complex environment of the healthcare industry, relationships between actors are not as simple as in many other industries: for example, patients receive services from hospitals and doctors, but pay premiums to a health insurance provider. Hospitals, in turn, bill the health insurers. Regulation plays an important role in this industry and influences the relationships between the other actors. Money and services are often not exchanged directly, and the receiver of services often is not the payer. To cope with this situation, the founders developed a series of business models with different configurations of network partners before settling on the model that is taken to market.

CASE 3: SEMICONDUCTOR WAFER MANUFACTURER

Semiconductor wafers are an important material input for integrated circuits and other electronic components; therefore, a manufacturer able to offer wafers with unique, desirable properties for a given application holds a potentially powerful – and valuable – position in the industry's value chain. On the other hand, the high speed of innovation in the industry threatens obsolescence in many ways. The necessity of close cooperation with a large number of partners for indispensable services, and the complexity and size of the value chains in the industry make it hard to exploit such a position. In this situation, the careful design and continuous adaption of the business model already is an important and difficult decision problem even for an established firm's management. In this case, things are even more complicated.

Research results and experience in wafer manufacturing technology gained at a

university were spun off into a start-up. The specific wafer material in question is necessary for the manufacture of electronic components for a number of applications in completely different markets, all of which are expected to grow at high rates over the medium to long term. This adds another dimension to the business modelling problem: Which and how many of these markets should the venture address?

The consumers – the final customers of finished goods – are removed from the case firm by several steps in the value chain: wafers go to component manufacturers, who supply parts to device manufacturers or integrators; these may produce finished goods, or several more intermediate steps may follow. The type and properties of the final products, however, have an impact on the total value generated, as well as on the proportion of this value that can be captured by the wafer manufacturer. In yet another dimension in the decision problem, the start-up could also perform any one or a combination of several possible roles in the value chain: it might become a manufacturer in its own right, or work as a technology and service provider to other manufacturers, or simply act as a licensor of intellectual property.

Since the semiconductor industry is in a state of mainly technology-driven change, the start-up's management used business modelling to keep track of all strategic options and to investigate their effects on value creation and capture. Globally speaking, the firm's situation is as follows: The venture itself consists of an R&D department close to the university and of a production arm, which are linked mainly through information exchanges. There are three market types, all of which might be served by the company. Suppliers are a necessary part of this business model, but are not critical since there are multiple sources for all inputs.

Analysis of the business model pointed out one decision option to the entrepreneurs, in which regulatory and demand-side pressure in the lighting industry leads to the expectation of high growth in the market for LED lighting, one of the markets in which the specialist wafers made by the start-up are indispensable, and therefore quite valuable. The situation allowed the start-up to enter a close partnership with an LED manufacturer – in principle a customer – exchanging not

only products and money, but also know-how on production processes, customer requirements and markets. This results in increasing sales through this channel, on the one hand, while potentially reducing or even removing both any other LED manufacturers as well the other markets, on the other hand. This situation can now be analysed in more detail for its impact on the start-up's value generation.

6. DISCUSSION

The cases described in this paper are selected to demonstrate the general utility of working with the BMDF in designing the business model in the venture creation process. Additionally, the framework can be used to design, alter and adapt the business model in accordance with changed environmental circumstances or changes implied by the company itself. At the same time, the cases and their business models provide an interesting insight into the mutual influence of technological change and entrepreneurial activity.

6.1 RESULTS OF BMDF APPLICATION

The precious metals trader case demonstrates how changes in technology can instigate entrepreneurial activity that does not have a technological development at the centre, but uses the new technology as an enabler for a new, previously impossible or impractical business model. Here, the technological enabler was the availability of cheap communications via internet and of powerful computers, which together made it possible to manage and control a widespread, but locally small-scale precious metals buying and arbitraging operation. The entrepreneur, after gaining knowledge of the market and the potential customers (private small-scale sellers of precious metals), was able to assemble a business model that introduced a new actor – the retailers hosting the store-in-store modules – and took advantage of these technological enablers to set up a profitable business. It is interesting to note that all elements of the new business model in this case were in existence before its design – even the trusted retail locations. The main contribution from the entrepreneur came from arranging the existing elements in a new way to generate value, and introducing a business model change in order to achieve this.

In contrast to the previous case, the telemedical stroke care advisory service is an example of technology product and service development driving business model change. The development of fast, ubiquitous data networks and of cheap high-resolution video cameras allows this firm to transform the business model of stroke care from transporting patients over long distances, with questionable prospects of success, to sending bits over networks. The important insight in this case is the role of the specialists and the time factor. The specialists are at the same time the most important and the scarcest element of the business model. The time factor is a limiting element: the length of the treatment window is fixed, and very short. The technology is very much at the centre of the service delivered, since with its help, the old business model is basically turned on its head: instead of bringing the patient to the specialist, which takes a long time, the specialist is brought to the patient, which is easy and fast in comparison. The business modelling process helped the founders to make sure that the network of actors was always set up in such a way that everybody received a net gain in value under the new model. In the complex environment of the healthcare industry, this is no easy task.

In the case of the wafer manufacturer, the situation was different: a decidedly high- technology start-up tried to position itself in a global network of suppliers, partners, customers, and consumers. At first, the business model looked simple – the firm would buy raw materials and sell a semi-finished good. Closer analysis, however, resulted in the realisation that things were not that simple. On the one hand, the newly developed technology gave the entrepreneurs a large number of potential options for positioning; on the other, the firm's environment was changing fast and had many unknown parameters. The firm's business model had to keep track of these changes and uncertainties. It helped to keep this process organised by identifying the important elements of the venture and focusing the entrepreneur's attention on them. At the same time, the big picture was kept in view, to make sure that nothing important was overlooked. This provided the flexibility and adaptability that was essential for frequent changes and what-if experimentation during iterations in the firm's venture creation process.

6.2 General effects of business modelling

From designing the business model, and comparing different versions and options, an entrepreneur can, as described above, gain insight into a number of areas. Conceptualising a new business model requires creativity, insight, and information. An entrepreneur may be able to intuit a new model, but not be able to rationalise and articulate it fully as in Case 1; so experimentation and learning is likely to be required. As mentioned earlier, the evolving reality that influences customers, the environment and the cost structure of the business must be understood. It is often the case that the right business model may not be apparent up front, and learning and adjustments will be necessary: new business models represent provisional solutions. A business model is provisional in the sense that it is likely to be replaced over time by an improved model that takes advantage of further technological or organisational innovations. Learning and adjusting are key issues to succeed in the market place.

One of the main tasks of an entrepreneur is generating, managing and ultimately harnessing a network of resources which often are not under his full control (Dubini and Aldrich, 1991; Wickham, 2006). Therefore, our approach puts its emphasis on describing this network as a starting point for further modelling work. The BMDF is designed to help the entrepreneur understand the structure and environment of his venture, and supports his strategy design work. It clarifies the complex and ever-changing situation that is characteristic for the venture planning process, and highlights the value creation potential at every step during this process.

The positioning of – and relationships between – the actors shows their relative importance, which may lead to emphasis on certain contract negotiations, or to the search for alternative actors, or to completely different ways of achieving certain goals. The first effect was an important contribution in the case of the wafer manufacturer. In the stroke care advisory start-up in Case 2, business model design helped the entrepreneurs to turn the conventional way of doing things on its head. The degree of dependence on certain actors becomes known as well. From this, the entrepreneur builds a good overall understanding of the structure of his new

venture. This is an important requirement for redesigning the business model, e.g., when considering what-if-scenarios, when reacting to new developments in suppliers' products or if a newly developed product is tested with customers.

The business model also gives information about the network complexity. Since all elements in the model have a representation in the real world, and these real-world elements of the network need to be managed or controlled in some way by the entrepreneur, there is a limit to how complex a business model can be for a given managerial capacity. A start-up in the complex semiconductor industry is a good example of this situation, and the small company in our Case 3 was able to analyse the situation's complexity in detail. The dynamic component of the framework allows for planning an orderly growth in this environment. In addition, early recognition of too-complex situations allows restructuring of the model before irreversible decisions are taken.

Finally, the model displays the value creation potential of the venture, with all its contributors, their importance, and their roles. The entrepreneur can tune the model, trying out different configurations of value-creating actors and relationships as in Case 1 thereby optimising his profit-making ability. From this tuning work may in turn spring impulses for new developments in the entrepreneur's technology and products as in Case 2 were new add-on services are now implemented for pre-clinical care.

6.3 THE RELATIONSHIP BETWEEN TECHNOLOGICAL CHANGE AND BUSINESS MODEL DESIGN

Technology use in new ventures influences the business model in ways that result in changes in the business model in order to enhance the start-ups ability to act successfully in the market. We found three main types of relationships (see tab. 2). First, for technology-adapting start-ups the business model is an enabler, because newly available technology on the market can enable the firm to implement a value-generating business model. Second, for technology-intensive start-ups, the business model based on the deployment of the technological core of the venture can help ensure that the technology actually delivers value. Third, for technology-

advancing start-ups, the business model acts as a design and analysis agent by combining the above-mentioned tasks. The BMDF supports the process of analysing, understanding and designing new links in the business model that take new technological aspects (external or internal) into consideration, adding value to the venture as a result.

Start-up is…	*Technology is…*	*Business model main task*
Technology-adapting (Case 1)	BM enabler	Analysis – newly available technology may enable value-generating business model
Technology-intensive (Case 3)	BM driver	Design – the business model ensures that the technological core delivers value
Technology-advancing (Case 2)	BM enabler or driver	Analysis and design of value creation and capture

Table 2: Relationship between technological change and business model development

A start-up developing a new product or service can actively use the business model methodically in its development process. Early exposure of prototypes to customers and feedback gathered from this can be used explicitly to adapt both the business model as well as the product under development. The precious metals trader in Case 1 was able to follow this path: without large capital expenditures, the entrepreneur tested and refined the business model at a small scale, optimising the design of the links between actors, before scaling it up. This goes hand in hand with the observation that technological change often provides the impetus for new and better ways to satisfy customer needs, as in Case 2. Generally, when the underlying technology changes, the business model must change too.

7. IMPLICATIONS

7.1 IMPLICATIONS FOR PRACTITIONERS

This study is, by design intended to generate theory elements for further research.

Despite this, the findings on the relationship of technology development and business model change described in the previous chapter lead to several implications for entrepreneurial practice, including entrepreneurs themselves, educators and policy makers in the area of entrepreneurship support.

The most obvious observation for entrepreneurial practice is the importance of a venture's resource base and network structure, and the fact that these are not static, but dynamic elements. Continually adapting these elements to changes in technology, the environment, and to new external challenges from the very start is an important driver of success. Entrepreneurs must first construct their resource, relationship and network base and build a foundation from which capabilities can be developed. People, relationships, and networks are as much a part of a business model as are technological dependencies and economic exchanges, and thus contribute to the venture's success.

The process of working with the business model can be of great value for entrepreneurs. Planning the development of the venture, the business model gives them room to sort the available alternative paths for opportunity and market exploitation, based on the interrelation with available technology – both for product or service development and for business model purposes. The business model helps to understand the interrelations of network partners and activities. Since business model change plays such an important role, entrepreneurs should include it in their planning processes.

In entrepreneurship education, business modelling is a good vehicle for translating a creative idea or recognised opportunity into a real business concept. Given the time constraints imposed by most course programmes, performing the necessary research to develop a fully-fledged business plan within a semester can be quite difficult, and often requires a lot of ancillary work by students that is not strictly useful for understanding the central ideas of entrepreneurship. Teaching business model-based entrepreneurship also allows much better illustration of the importance of evolving the business model during the venture creation process, since it is much easier to demonstrate and discuss this concept by means of a business model than it would be to discuss changes between multiple versions of a purely

textual business plan.

For policy makers, the results on low-tech entrepreneurship may provide a motive to look into support programmes that are not targeted exclusively on high-technology ventures. These could offer specific training in business model design and in using technology for business model innovation.

7.2 Implications for research

The approach underlying this analysis has several limitations. The results cannot be assumed to be typical of all businesses. Since we examined only cases from our university's spin-off support programmes, there may be a location or industry bias. The quality of the case descriptions may vary; despite our generally close proximity to the developing ventures, there may be differences in insight or access. This proximity may also cause personal biases, which we tried to reduce by discussing cases and interpretations with a number of colleagues involved in the spin-offs. However, the detailed insights available from being able to take part in a new venture's early development are, in our view, worth coping with these limitations.

In the course of our study, a number of insights, but also some open questions, were revealed. The usefulness of longitudinal studies of new ventures for research on business model development became apparent. Our data set has been built over a number of years. Ideally, these studies would be conducted in close proximity to and in cooperation with the founders. In this way, motivations and backgrounds of decisions can be documented, and details of business model elements and changes from one version to the next can be explained in context. The large effort required for this type of research will always be a barrier to creating large data sets quickly. However, certain start-up support programmes, which mostly are conducted by public institutions (e.g., chambers of commerce, universities, innovation and business agencies), would be good venues for anchoring such long-term research, with those programmes most suitable that offer early-stage support.

Much previous research has high-tech entrepreneurship as its main subject. This is based to a large part on the belief that only high-technology firms can create me-

aningful value. Our findings on technology use in the design of new business models show that low-tech entrepreneurship can also be an equally interesting topic. In many cases, a start- up based on a specific technological development does not look very interesting from the business model perspective, especially if product, market and value proposition are obvious from the start. In contrast, for many low-tech ventures, the business model – in its depiction of the value network – itself contains the core value proposition and is therefore of a considerably higher importance. An interesting question here is whether business model-based, low-tech, start-ups mainly exploit the 'internet effect' of cheap communications and easy management enabled by networked computers, or if there is genuine business model innovation; and in the latter case, if there are identifiable common elements.

The business modelling process would benefit from further development of the BMDF method. Model comparisons and decisions based on business modelling could be improved with appropriate quantification of model elements, especially of flows and influences. Ideally, it should be possible to determine a quantifiable total value for a business model. This would at the same time be a first attempt at assessing the quality of a business model, which is important for conducting systematic design and development work as well as for business model research.

Finally, research on success factors in business model design and development is required. This would entail looking at possible correlations between business model changes and growth or other desirable outcomes (e.g., winning investors or achieving profitability).

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PAPER 4

Health Care Decision Making in Telestroke:

An Exemplary Study Using the Analytical Hierarchy Process

Franziska Günzel

Abstract

The main challenge of innovations in the health care service delivery sector lies in their dissemination rather than their creation. In the present study, an instructive example for deferred dissemination of a meaningful medical service was analyzed: telestroke care in Germany. In an assessment from the primary care physician perspective, the analytical hierarchy process (AHP) was used to determine an optimal telestroke network concept for the German state of Saxony-Anhalt. All queried hospitals exhibited a unanimous 60% preference for one concept—the telestroke ward—over the two other alternatives (23% and 17%). Advancing to a design perspective, this unambiguous result suggests to adapt the currently restricted telestroke ward concept to a wide range of hospitals, thus making its strong benefits available to a larger number of stroke patients. This study advocates including physicians in health care innovation assessment and selection by the widespread application of the AHP, thereby supporting translation of meaningful cost-effective innovations into practice.

Keywords: analytic hierarchy process, decision making, health care, multiple criteria, telestroke

1. INTRODUCTION

In western industrialized countries, health care and the environment for its delivery are changing rapidly. In Germany, 278,345 million Euros, or about 11.6 percent of GDP, was spent on health care in 2009, with increasing tendency (GBE, 2011). In fact, in the last decade health care expenditures have been growing faster than the economy, jeopardizing sustainability, since statutory health insurance premium is coupled to individual income in Germany. Innovations may simultaneously contribute to improving health care delivery and relieving the financial burden on statutory health insurance. Such innovations and entrepreneurial activity have mainly been examined in sectors like biotechnology, genomics, and pharmaceuticals, but also play a key role in the service delivery area, where innovations lead to products and processes that improve quality of care, accessibility, and continuity of services delivered within and across facilities and communities (Grazier and Metzler, 2006). The main challenge of innovations in this sector is not their creation, but rather their dissemination (Ferlie et al., 2005). Ferlie et al. (2005) found that in particular strong boundaries between professional groups at the level of medical practice slow down innovation spread. Hence, involving medical professionals in the decision process about the introduction of innovative health care delivery products and services may improve acceptance and thus speed up dissemination.

“Telestroke” care in Germany is an instructive example for deferred dissemination of a meaningful, cost-effective medical service. Aiming at improving acute stroke patient care in underserved areas, telestroke networks provide neurological expertise from specialized stroke units to small primary care hospitals (Audebert, 2006; Müller et al., 2006). Due to various environmental factors and personal preferences, different types of telestroke networks have emerged especially in Europe and the United States within the last ten years (Schwamm et al., 2009a; Günzel et al., 2010).

In these networks, various pilot studies have demonstrated that valid decisions on thrombolytic therapy, the most important and time-critical therapy for the majority of acute stroke patients, and on a variety of further special interventions can be

made accurately with the aid of telemedical expert support (Audebert et al., 2006; Audebert et al., 2009). With published efficacy results of these pilot projects available today, a wide spectrum of primary care hospitals, health care leaders, professional groups and policy makers have become increasingly interested in neurological teleconsultations (Ickenstein et al., 2010). This was also true for the German state Saxony-Anhalt. In 2008, German state politics made the resolution to implement a telestroke network in Saxony-Anhalt. Therefore, both regional hospital structure demands and currently existing networks were investigated in-depth to lay the foundation for the decision concerning a telestroke concept. Three prototypical telestroke network concepts, which target different hospital types were determined as possible alternatives (Günzel et al., 2011), but no uniform optimum for all 26 hospitals currently treating stroke patients in Saxony-Anhalt could be identified since those hospitals differ strongly in e.g. size, in-house neurological expertise, focus in stroke care and current network relationships. A decision concerning the most suitable network concept for this diverse range of hospitals was needed.

Based on the study of Günzel et al. (2011), this study takes a novel approach to the telestroke decision problem, modeling it from the "customer" viewpoint of a primary care hospital by the Analytical Hierarchy Process (AHP) (Saaty, 1980). In interviews with chief physicians of primary care hospitals, decision criteria were collected and subsequently structured hierarchically to fit the AHP decision scheme. In a second set of interviews with dedicated telestroke experts, the three previously identified alternative network concepts were ranked with respect to the criteria. With this novel approach, this study contributes to the research stream on health care innovation and presents an interesting AHP application to decision making in the health care delivery sector.

The paper is organized as follows. Section 2 introduces the reader to telestroke care and gives a brief overview of three leading network concepts. Section 3 presents the decision analytical approach and data collection strategy. In section 4 the hierarchical model used for collecting and structuring the data is shown. Sections 5 to 6 present the hospital priorities, the ranking of alternatives as well as results of the sensitivity analysis. The last two sections present the discussion and con-

clusions.

2. TELEMEDICAL NETWORK CONCEPTS IN STROKE CARE

Stroke is the third leading cause of death and main reason for adult long-term disability in western industrialized countries (Kolominsky-Rabas et al., 1998). Stroke is an emergency: since damage to neuronal tissue is fast and irreversible, for patients every minute counts. In stroke units providing special multidisciplinary expertise, acute stroke patients receive highly efficacious care, in particular time-critical thrombolytic therapy to re-open occluded brain-supplying vessels by the "clot-busting" drug Tissue plasminogen activator (t-PA) (Pollack et al., 2007). Implementing state-of-the-art standard operating procedures for stroke patient care, stroke units provide 24/7 monitoring beds, laboratory and X-ray computed tomography (CT), as well as early rehabilitation (e.g. physiotherapy, speech and occupational therapy). Furthermore, stroke patients eligible for neuroradiological intervention are immediately identified and transferred to a nearby neurointerventional department.

However, stroke units cannot be implemented in particular in sparsely populated rural areas because of a shortage of experienced neurologists (Audebert and Schwamm, 2009). To compensate for this lack of neurological expertise, stroke unit "hubs" have been linked to small primary care hospitals ("spokes") in telestroke networks (Audebert, 2006; Müller et al., 2006), where experienced neurologists provide remote teleconsultations to emergency room physicians in primary care hospitals, together enabling appropriate stroke therapy.

In such telestroke networks, the neurological teleconsultant can view the patient's brain scan (CT or Magnetic resonance imaging) and is connected to the primary care hospital by a high-quality video and audio transmission link, so that he can observe the patient exam carried out bedside by the resident or attending physician. Having full control of the pan, tilt and zoom functions of the bedside camera, he can perform a thorough clinical assessment of the patient's neurological status. On the basis of the information thus gathered, the stroke expert communicates his diagnosis and related therapeutic recommendations to the physician and

finally provides a medical report sheet (Schwamm et al. 2009b). Up to now, individual stroke experts have been the major driving force behind establishing and running telestroke networks. It is therefore not surprising that current telestroke network concepts differ widely according to personal preferences, national funding opportunities, regional factors and different foci in stroke care.

From a structural perspective, the leading active telestroke network approaches represent three different fundamental concepts: (1) drip-and-ship, (2) commercial neurological teleconsultation and (3) telestroke ward. These three network concepts constitute the alternatives for the decision problem examined in this study and are specified below in more detail by introducing an exemplary network (the description is based on Günzel et al. 2011).

2.1. DRIP-AND-SHIP CONCEPT

The world's first telemedical stroke care network "Partners TeleStroke Center" started back in 2001 at the Massachusetts General Hospital (MGH) with two remote hospitals in Boston/USA (www.telestroke.massgeneral.org). Today, two academic stroke centers at MGH and Brigham and Women's hospital provide about 200 acute stroke teleconsultations for 21 community hospitals in Massachusetts, New Hampshire and Maine per year. These primary care hospitals are mostly small community hospitals with CT-scan and laboratory available around the clock (Schwamm et al., 2004). It is the aim of the Partners Telestroke Center network to promote these community hospitals to the status of an "acute stroke capable" hospital.

Implementing a "drip-and-ship" concept, the Partners TeleStroke Center network focuses on early identification of thrombolysis candidates in the network's primary care hospitals. Acute stroke patients admitted to a primary care hospital within the thrombolytic time window of 4.5 hours after symptom onset can be presented to the telestroke consultant, who discusses the findings with the on-site physician, and both together decide on a plan of care – in particular, the intravenous application of the clot-busting drug t-PA ("drip"). Up to 50% of the patients receiving t-PA, especially those developing complications, are transferred to one of the aca-

demic stroke centers ("ship"). Due to this narrow indication spectrum, all other acute neurological patients need to be treated or transferred by the primary care hospitals on their own. The neurological experts stress the relevance of the local network design and their personal educational relationship to the community hospital physicians, relying on the academic excellence of the university stroke centers (Farrell et al., 2008).

The total costs for both stroke centers and network hospitals are comparatively low, because Partners TeleStroke Center neurologists provide the teleconsultations as part of their in-house routine, and the community hospitals can request up to twelve consultations for an annual fee.

2.2. COMMERCIAL NEUROLOGICAL TELECONSULTATION

The first commercial provider of acute neurological teleconsultations, Specialists on Call (SOC), was founded in 2003 by an international renowned neurologist. With 30 appropriately accredited and licensed neurological consultants spread all over the country, SOC currently serves the biggest network worldwide and offers around 1,000 consultations per month to 100 hospitals in twelve US states. SOC uses a globally distributed network structure of both primary care hospitals and neurological consultants without any regional hub-and-spoke relationship around a stroke center. SOC has followed this global, scalable approach to teleconsultation from its inception, and addresses a wide spectrum of customer hospitals with solutions tailored to the hospitals demands to most perfectly supplement the existing in-house expertise (McDonald, 2008). This includes different service options as e.g. 24/7, night-shifts only or at the weekends as well as relocation management for urgent patient transfer. While stroke patients constitute approx. 71% of all incoming requests, SOC in principle answers all inquiries about neurological patients.

In practice, a hospital affiliated with SOC contacts a call center managing the distribution of incoming requests to the neurological consultants and making sure that these have the necessary anamnestic, CT and hospital data available. The neurological consultant "on call" then calls back to the inquiring hospital and arrang-

es the consultation from his telemedical workstation.

Hospitals contracting with SOC pay a fixed initial fee for provision and installation of the hardware, with monthly rates depending on hospital size, average stroke incidence and type, but independent of the actual number of teleconsultations. Alongside the medical support service, SOC maintains the provided equipment (McDonald, 2009).

2.3. TELESTROKE WARD CONCEPT

Germany's most successful telemedical network TEMPiS (www.tempis.de) was founded in 2002 as a pilot project publicly financed by the Bavarian State, the German Stroke Foundation and Bavarian health insurances. In 2006, TEMPiS managed the transition to regular health insurance financing based upon a special reimbursement contract. Today, two comprehensive stroke centers (Munich and Regensburg) provide about 3,500 neurological teleconsultations per year to 15 community hospitals in eastern Bavaria (Vatankhah et al., 2008).

TEMPiS systematically follows an integrative, regional approach for stroke care which is based on the idea of transferring the stroke unit concept to hospitals lacking neurological expertise. There are several essential building blocks of the TEMPiS concept. First and foremost, network hospitals have to establish a separate "telestroke ward", a full-blown stroke units "minus 24/7 neurologists". They also need to have specially trained personnel for early rehabilitation (e.g. physiotherapy, speech and occupational therapy). The implementation of standard operating procedures for stroke patient care is the third pillar of the TEMPiS concept, and goes hand in hand with the introduction of dedicated quality management and a regular education and training program both for physicians and nurses. TEMPiS strongly emphasizes the personal relationship between stroke center experts and network hospital physicians and nurses (Müller et al., 2006).

Due to the high telestroke ward installation and running costs, TEMPiS focuses on medium-sized hospitals which treat at least 200 stroke patients per year. Although annual expenses for TEMPiS exceeds those of other network types due to considerable telestroke ward requirements, they are currently being reimbursed by German statutory health insurance on an individual contract.

Table 1 presents an overview of these three network concepts according to their different aims and geographical coverage, and gives prototypical examples. All three established network types obviously target different hospital groups. For economic reasons, the state government in Saxony-Anhalt could only establish a single telestroke network, thus facing a decision problem about the most suitable network concept among the three given alternatives.

	Drip-and-Ship	**Commercial neurological teleconsultation**	**Tele stroke ward**
Target hospitals	Small non-stroke educated hospitals	Hospitals of various size and education level	Medium-sized hospitals with a basic level of stroke education
Aim	Building up stroke capable hospitals, transferring patients eligible for t-PA therapy or neurointervention	Complementing in-house expertise	Building up advanced stroke expertise in connected hospitals, reducing patient transfer
Primary role of service provider	Advisor, Educator, Tertiary care center for patient transfer	Connector, Consultant	Educator, Consultant, Patient transfer facilitator, Quality manager
Geographic	Regional approach	Global approach	Regional approach
Example	Partners Telestroke Center in Boston, MA, USA	Specialists on Call Inc. in Leesburg, VA, USA	The Telemedical Pilot Project for Integrative Stroke Care in Munich, Bavaria, Germany

Table 1: Main characteristics of three network concepts

3. CHOICE OF DECISION METHOD AND APPLICATION

When a decision aid was designed for the problem at hand, it was considered to be important that it is situation-based, i.e. when meeting with chief physicians no outside knowledge should be needed to carry out the assessment. The decision aid should only offer a frame for structuring the problem. In the present telestroke decision problem, criteria queried from decision makers are often dependent on each other and may quite naturally be ordered hierarchically rather than on a single level. Due to the fact that criteria are valued on inherently incommensurable scales, no separate utility function can be defined in the telestroke decision prob-

lem, but the aggregation of weights to the final priorities must be determined consistently within the decision method. Additionally, the choice of the weighting method was directed by the awareness that too mathematical, complex and time-consuming methods could risk any real-life interview process especially in a hospital setting. The so-called SMART method was one alternative (Hammond et al., 1999). However, the choice for this study was the AHP. AHP has previously been used in numerous applications to project and technology evaluation in health care, to prioritization of health care organizational processes and information systems, as well as health care facility evaluation and policy analysis, thereby affirming its practicability in the area (Liberatore, 2008). An additional important factor was the availability of proven software for data collection and analysis. In the next section, the main steps of the AHP method are briefly sketched (for a more detailed review please see Saaty (1980), Saaty (1986), Saaty (2000), or Vaidya and Kumar (2004)).

3.1 The Analytical Hierarchy Process

The application of AHP to a decision problem involves four steps: (1) modeling the criteria hierarchy, (2) determining the relative weights (local priorities) and calculating inconsistency, (3) aggregating the weights to the final priorities of the alternatives, and (4) sensitivity analysis. The first step includes the decomposition of the decision problem into criteria or objectives according to their common characteristics, and establishing a hierarchical model with different levels. The single top-level element, the focus of the hierarchy, is the overall goal of the actual decision problem, while the lowest level contains the decision alternatives. In the second step, a matrix of relative weights for the criteria is implicitly calculated from all pairwise comparisons: on every hierarchy level, the relative importance of a pair of criteria is determined with respect to the common "parent" objective on the level above, and this procedure is iterated over the entire hierarchy. The comparison of any two criteria C_i and C_j with respect to the parent objective is made using questions of the type: 'Of the two criteria C_i and C_j, which is more important with respect to the parent objective, and how much more?'. Saaty (2000) suggested the use of a nine-point scale to transform the verbal judgments

into numerical quantities. Once the judgmental matrices of comparisons of criteria with respect to their parent criteria as well as alternatives with respect to the lowest-level criteria are available, the local priorities are obtained and the consistency of judgments is determined. In order to produce overall priorities which serve as ratings of decision alternatives, one has to synthesize the priorities. Finally, using the resulting scores leads to a provisional decision and its robustness can be examined by sensitivity analysis.

3.2 DATA COLLECTION

Data was collected in a three-step process. First, all important criteria regarding optimal telemedicine network selection were identified by contacting all hospitals in Saxony-Anhalt that are involved in stroke patient care. Second, chief physicians were queried to assess the weights and, third international renowned experts were interviewed for final assessment of the alternatives.

To determine the criteria for the hierarchy, all hospitals in Saxony-Anhalt involved in stroke patient care and possibly interested in telestroke were addressed in writing. The letter first asked in an open question, which criteria would be important for the hospitals when evaluating a network, and second prompted selecting criteria from a list (17 items) generated from a previous study (Günzel et al., 2010). Nine out of 26 hospitals replied enumerating an average of 4,44±2,01 and selecting an average of 11,78±3,35 criteria. After correction for multiple occurrences of similar terms, all selected criteria were subsequently grouped in a three-level hierarchy that was discussed and iterated with expert physicians.

In the next step, the nine hospitals that had replied to the first call were asked for face-to-face interviews on-site. A team of two interviewers queried eight out of nine chief physicians in individual sessions in August and September 2010. According to the AHP procedure, they were asked to weight all 24 pairwise comparisons of criteria on the nine-point scale. Each comparison was performed on a separate sheet of paper graphically displaying the scale because interviewees preferred this mode. Interviewees were permitted to ask questions in case of doubt. Besides answers, questions and comments the following general data concerning

the hospital was collected: number of beds, number of stroke patients, length of stay of stroke patients, department structure, in-house neurological expertise, co-operation with the Emergency Medical Service (EMS) and rehabilitation facilities as well as distance to the next stroke unit. Chief physicians were only asked to assess their decision criteria and not the alternatives.

In order to weight the alternatives with respect to the lowest-level objectives, face-to-face interviews with three well-known experts from the field of acute telestroke care were conducted subsequently. These experts were selected by applying the criteria (1) familiar with the given different network concepts, (2) having international standing in the field of telestroke care, (3) being well published in peer-reviewed journals. Three out of four national and international experts fulfilling the above criteria agreed to the request and were interviewed in October and November 2010. Similar as during the first set of interviews, experts were presented with graphical displays for all 48 pairwise comparisons. Questions and comments explaining their scoring were documented.

3.3 DATA ANALYSIS

Existing telestroke network concepts address different types of hospitals depending on size, stroke incidence and in-house neurological expertise. Therefore, the hospitals participating in this study were grouped according to these factors (see tab. 2). The first group comprised three small and non-stroke educated hospitals H1 to H3. The second group contained three medium-sized hospitals H4 to H6 aiming at advanced stroke care, while the third group consisted of the stroke-educated hospitals H7 and H8 (for a complete list of hospitals participating in this study please see appendix A).

For data analysis the Expert Choice Comparion Suite software was used. To quantify the hospitals' priorities, a criterion's global priority (GP) measuring its contribution to the overall goal was determined. Additionally, inconsistency ratios (IR) were determined for each criterion and each rater. The final ranking of alternatives with respect to choosing an optimal telestroke network was obtained by aggregating the primary care hospitals' priorities with the telestroke experts' weighting.

This analysis was performed in aggregated form for all hospitals, and subsequently stratified for the three hospital groups from the pairwise comparison based on the normalized right eigenvector of the geometric average of the judgements. Finally, sensitivity analysis was performed.

	# beds	**# stroke patients treated (2008)**	**In-house neurological department**	**In-house neurological expertise**
H1	233	113	Not existing	Not available
H2	134	100	Not existing	Not available
H3	114	156	Not existing	Not available
H4	566	264	Not existing	Contract with a consultant neurologist
H5	454	281	Not existing	Contract with a consultant neurologist
H6	243	260	Not existing	Neurologist half-time in-house
H7	327	252	Regional Stroke Unit	Neurologists full-time in-house
H8	585	345	Regional Stroke Unit	Neurologists full-time in-house

Table 2: Categorization of the eight participating hospitals

4. DECISION HIERARCHY

In an attempt to structure the process of deciding about an optimal telestroke concept, a hierarchical decision model is presented (see fig. 1). The overall goal of the hierarchy was the choice of an "optimal telemedicine network structure" for acute stroke care. Below this goal, four objectives on the first level were modeled, while the maximum depth of the criteria hierarchy was three levels.

The first-level objectives address the domain of patients, economics, reputation and staff. An obvious objective of associating with a telestroke network was "Improving individual patient care", while financial aspects were subsumed under "Improving the current economic situation". Two objectives less obviously found on this first level dealt with "Improving the hospital's reputation" and "Improving employee satisfaction", which were both considered to have effects partially independent of patient outcome and hospital earnings.

The criterion "Improving individual patient care" was subdivided into the objec-

tively measurable subcriterion “Improving patient outcome” (e.g. measured by clinical scores like modified Rankin Scale, National Institutes of Health Stroke Scale or the care level) and the subjective subcriterion “Improving patient satisfaction” (e.g. patients feel they were taken good care of or received support when needed).

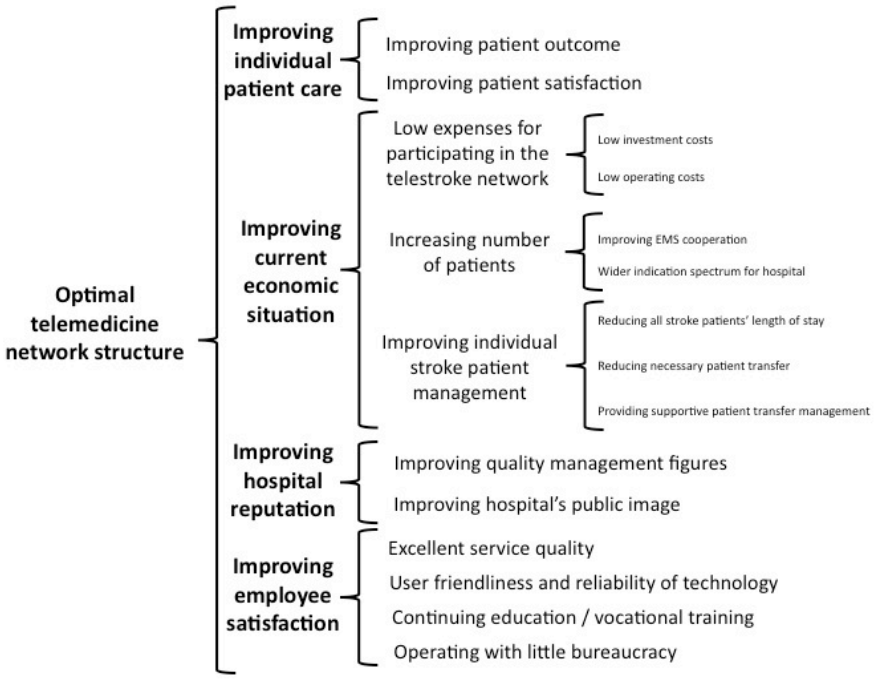

Figure 1: Hierarchical decision model

The criterion “Improving the current economic situation” was divided into objectives related to costs by the sub-criterion “Low expenses for participating in the telestroke network” and related to earnings by “Increasing the number of patients”, as well as to rationalization and process streamlining by “Improving individual stroke patient management”. In this way, quantitative effects on the number of admitted patients and on the efficiency of individual patient management were separated. “Low expenses for participating in the telestroke network” was in turn subdivided into “Low investment costs for participating in the telestroke network” (e.g. expenses for setting up a separate unit, purchasing telecommunication hard- and software) and “Low operating costs for participating in the telestroke network” (e.g. expenses for additional staff, annual telestroke network fee). The

number of admitted patients could be increased by “Improving cooperation with Emergency Medical Service” (getting more stroke patients), by offering a “Wider indication spectrum for the hospital” (getting additional patients who previously could not be treated in-house and were admitted to other hospitals before the availability of teleconsultations), and by “Improving the hospital’s reputation” (getting more patients directly or by transfer from general practitioners, who trust this particular hospital). Process streamlining in patient management could be improved by “Reducing all stroke patients’ length of stay” (less effort for a patient at the same Diagnosis Related Group reimbursement), by “Reducing necessary patient transfer” (being able to keep patients that else would have to be transferred for adequate treatment) and by “Providing supportive patient transfer management” (teleconsultants take care of patient relocation to tertiary care specialties or rehabilitation facilities if needed).

The criterion “Improving the hospital’s reputation” was considered complementary to and even transcending improvement in patient care and hospital earnings. It was subdivided into “Improving quality management figures” (e.g. in-hospital mortality rate), which are published on a biannual basis in Germany, and “Improving the hospital’s public image” (e.g. favorable press coverage in local media). Chief physicians stressed that this had a relevance entirely of its own, and was not only a means of improving the economic situation.

The criterion “Improving employee satisfaction” described how well the clinical staff—physicians and nurses—get along with the human and technological aspects of teleconsultation. Its sub-criterion “Excellent service quality” measured the quality of interaction with the remote consultant, while “User friendliness and reliability of technology” addressed technological aspects of telemedical hard- and software. Two further sub-criteria contributing to employee satisfaction concerned “Continuing education / vocational training” offered by some telestroke networks and “Operation with little bureaucracy” since hospital staff was often afraid of increasing workload in documentation.

5. HOSPITAL PRIORITIES

The chief physicians’ assessment revealed that the decision hierarchy was strong-

ly dominated by the objective of improving patient care (see tab. 3). The two largest single contributions to choosing an optimal telestroke network stemmed from these patient-related items: improving patient outcome (47%; percentage numbers in parentheses are always GP, unless otherwise stated) and satisfaction (19%), making for a global priority of nearly two-thirds.

Objectives	**Local Priority**	**Global Priority**
Optimal telemedicine network structure	100,00%	100,00%
Improving individual patient care	65,37%	65,37%
Improving patient outcome	71,70%	46,87%
Improving patient satisfaction	28,30%	18,50%
Improving the current economic situation	13,22%	13,22%
Low expenses for participating in telestroke network	20,52%	2,71%
Low investment costs for network participation	23,05%	0,63%
Low operating costs for network participation	76,95%	2,09%
Increasing the number of patients	27,96%	3,70%
Improving EMS cooperation	34,69%	1,29%
Wider indication spectrum for hospital	65,31	2,41%
Improving individual stroke patient management	51,52%	6,81%
Reducing all stroke patients' length of stay	18,90%	1,29%
Reducing necessary patient transfer	39,87%	2,72%
Providing supportive patient transfer management	41,23%	2,81%
Improving the hospital's reputation	15,32%	15,32%
Improving quality management figures	41,00%	6,28%
Improving the hospital's public image	59,00%	9,04%
Improving employee satisfaction	6,10%	6,10%

Excellent service quality	27,18%	1,66%
User friendliness and reliability of technology	26,61%	1,62%
Continuing education / vocational training	22,01%	1,34%
Operation with little bureaucracy	24,21%	1,48%

Table 3: Final results for all hospitals as well as the three groups

6. RANKING OF ALTERNATIVES

The telestroke ward concept was clearly favored for choosing an optimal telestroke network at 60% priority (range 52%–66% between experts)—for all hospitals, in all individual groups and all individual hospitals, while drip-and-ship and commercial teleconsultation ranked at about 23% (18%–31%) and 17% (11%–30%), respectively. This rating was clearly dominated by the objective to improve individual patient care, for which the telestroke ward concept was ranked at 66% (55%–72%). This preference was unanimously shared by all hospitals, with drip-and-ship and commercial teleconsultation ranking at 20% (16%–26%) and 15% (10%–28%). Appendix B presents an overview of the rankings of alternatives for the hospital groups.

The clear preference for a single telestroke alternative, however, was not observed with respect to all criteria. For the objective "improving the current economic situation", the alternatives' priorities were much more balanced, with drip-and-ship ranking highest at 39% (29%–54%), telestroke ward at 35% (26%–44%) and commercial teleconsultation at 26% (15%–38%). Furthermore, the economics related picture was much more heterogeneous regarding the hospital groups: while small and medium hospitals favored drip-and-ship at 43% and 41%, respectively, stroke-educated hospitals favored telestroke ward at 45%.

Furthermore, the switch from small and medium hospitals' preference to stroke-educated hospitals' was examined by analyzing the three sub-criteria contributing to the economic situation. For increasing the number of patients, the telestroke ward concept clearly dominated at 46%–50% priority, while the two other alternatives ranked fairly equal at 24%–28%. Improving patient management was com-

posed by three very heterogeneously weighted sub-criteria, resulting in nearly equal priorities of 37%–41% for the alternatives telestroke ward and drip-and-ship, and 22% for the commercial solution. The objective of low telestroke expenses, however, was clearly dominated by the drip-and-ship concept at 57% priority in all three hospital groups. Here, the expensive telestroke ward concept ranked last. However, due to the low overall priority of economic criteria (GP 13%), their heterogeneity did not have much bearing on the ranking of alternatives regarding the overall goal.

Regarding the first-level objective to improve the hospital's reputation, the telestroke ward alternative was clearly favored at 67%–69% by all individual groups, while drip-and-ship and commercial teleconsultation ranked at 18%–19% and 13%–14%, respectively.

The frequently observed homogeneity across hospital groups was not found with respect to improving employee satisfaction, where the telestroke ward alternative was summarily favored at 44%, while drip-and-ship and the commercial solution ranked at 26% and 30%, respectively. While both small and stroke-educated hospitals clearly favored the telestroke ward concept at 51%–53%, medium hospitals were less decided and favored a drip-and-ship concept at 40% or even a commercial solution at 32%.

6.1 Sensitivity analysis

The unanimous preference for the telestroke ward network concept turned out to be extremely robust. Performing a sensitivity analysis yielded the global priorities of selected criteria under hypothetical variation of the direct subcriteria's weights. First, the priority for improving individual patient care was varied. Since the priorities for all three alternatives ran nearly parallel under hypothetical variation (0–100%) of the weight for improving patient care, a wide separation between the telestroke ward priority and the two others maintained. Indeed, under a hypothetical variation of the weight for improving the economic situation (13% in this study), the priorities for telestroke ward and drip-and-ship networks intersected at a value of 92%. This corresponds to a rather unlikely choice of priorities. In the subgroup of small hospitals, this intersection between telestroke ward and drip-

and-ship priorities occurred at 76%, which seems still unreasonable. It is therefore safe to conclude that the clear preference for telestroke ward networks does not depend on a particular choice of weights in the study, but rather represents a robust and generalizable result.

6.2 CONSISTENCY OF RATING AND CONSENSUS VIEW

The eight chief physicians' average IR varied between 0.06±0.09 and 0.23±0.24 while the three experts average IR varied between 0.05±0.05 and 0.08±0.07. With regard to experts' consensus commercial teleconsultation and drip-and-ship exhibited high consensus at 11% and 12.5% average standard deviation, while telestroke ward showed more disagreement at 17.6%. Analyzing individual criteria yielded a diverse picture. Experts e.g. agreed on the ranking of telestroke ward regarding low investment and operating costs, while strongly disagreeing on this for the other telestroke network concepts. These results reflect the diverse views on telestroke being controversially debated today. However, sensitivity analysis confirms that the observed variation in priorities leaves the overall ranking of alternatives unchanged.

7. DISCUSSION

The use of decision analytical tools in healthcare has increased in the last years considerably especially with the goal to rationalize decisions of public interest. Applying decision analysis to healthcare differentiates from decision analysis and support in industry or commercial services since healthcare organizations operate elsewise and are strongly embedded in their national context (Brailsford and Vissers, 2011). Additionally, decision making in health care involves a multitude of stakeholders whose interests need to be balanced. Despite the rise in number of decision analysis applications to health care problems, Royston's (1998) comprehensive schema shows that decision analysis in health care does not target the innovation dissemination process which. However, this area could especially benefit from the application of decision analysis since essential sources of differences in option can be pointed out and decision makers can gain in-depth understanding of the nature of the subject under investigation.

In the present study this problem was tackled. The AHP method was used to determine an optimal telestroke network concept for the German state of Saxony-Anhalt by involving primary care physicians in the assessment. In all hospitals queried, chief physicians showed a unanimous and strong preference for the telestroke ward concept over the two other alternatives. However, while joining a telestroke ward network may best meet the chief physicians' objectives, actual implementation of these networks is restricted by rigorous structural and organizational conditions (see section 2.3). In their current modus operandi, telestroke ward networks only address medium-to-large hospitals capable of fully meeting all their requirements.

The present study therefore identifies a conflict between primary care hospitals' demands and telestroke ward networks' supply. Crossing over from a decision perspective—choosing among exogenously determined alternatives—to a design perspective—improving given alternatives or creating new ones—(e.g. Keeney and Raiffa, 1993), it is therefore suggested to open up the much desired telestroke ward concept to a wider range of hospitals, thus making its strong benefits available to a larger number of stroke patients. This process of widening the network focus by relaxing its rigorous conditions could be guided by further results of this study. While the chief physicians' priorities were strongly dominated by improving patient care, the AHP priorities revealed interesting secondary preferences regarding economic criteria or employee satisfaction. In this study, several aspects have been identified where alternative telestroke network concepts outranked the overall preferred telestroke ward concept. In this way, telestroke network design could learn from the physicians' preferences—picking up proven features from other network concepts without giving up the strengths of the telestroke ward concept.

Taking the design perspective even a step further—and taking into account current trends in health care like customer integration and opening the sector to private health care providers—not only cost-effective means of health care delivery could strongly profit from results like they are presented in the current study, but also entrepreneurs entering this sector. Mixing decision- (cognitive) and design- (action) based approaches in business model development in the early-stage ven-

ture could put forward creative and innovative solutions which are strongly based on data generated from the future implementers and users. Involving potential customer and consumers in the first design phases can generate feedback, secure transparency and build a platform for communication and exchange. Decision analysis methods like AHP could thus strengthen business planning in sectors that are as complex as healthcare and thus not only speed up dissemination of innovation but also help entrepreneurs to succeed.

7.1 LIMITATIONS

There are certain limitations to the presented study. First, only one-third of all primary care hospitals in Saxony-Anhalt could be queried. This potentially introduces a responder bias since hospitals unfamiliar with telemedicine in general may have been less inclined to reply. Non-responders may in particular belong to the group of small hospitals being eligible for commercial neurological teleconsultation rather than for a telestroke ward concept. Second, hospitals located in the south of Saxony-Anhalt have responded less frequently, possibly introducing a regional bias. Third, the strong dominance of the objective improving patient care is probably caused by asking medical doctors whose primary concern is the patients' well-being, while administrative directors may have provided different priorities. This bias is also reflected in the low weighting of aspects like technical reliability and user friendliness of telemedicine hard- and software, which will be considered important by both telemedicine technology vendors and medical or nursing staff actually working everyday with the technology. Fourth, the group preference aggregation method used within the Expert Choice Comparion Suite software may not guarantee Pareto optimality (Chwolka and Raith, 2001).

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Appendix A. Hospital reference

H1: Altmark Klinikum gGmbH Krankenhaus Gardelegen (www.altmarkklinikum.de/Gardelegen)

H2: AGAPLESION Diakoniekrankenhaus Seehausen (http://startseite.dkh-seehausen.de)

H3: AWO Krankenhaus Calbe (www.awo-krankenhaus-calbe.de)

H4: Johanniter-Krankenhaus Genthin-Stendal gGmbH (www.johanniter.de/einrichtungen/krankenhaus/genthin-stendal)

H5: Gesundheitszentrum Bitterfeld / Wolfen gGmbH (www.gzbiwo.de)

H6: MEDIGREIF Kreiskrankenhaus Burg GmbH (http://www.medigreif-kreiskrankenhaus-burg.de)

H7: Klinikum Bernburg GmbH (www.klinikum-bernburg.de)

H8: Klinikum Magdeburg gemeinnützige GmbH (www.klinikum-magdeburg.de)

Appendix B. Final results for all hospitals and three hospital groups

	All hospitals	Small hospitals	Medium hospitals	Stroke hospitals
Optimal telemedicine structure				
Telestroke ward	60,40%	59,25%	60,91%	60,55%
Drip-and-ship	22,67%	23,29%	23,13%	21,72%
Commercial teleconsultation	16,93%	17,46%	15,95%	17,73%
Improving individual patient care				
Telestroke ward	65,66%	65,57%	66,04%	64,96%
Drip-and-ship	19,78%	19,68%	20,19%	19,02%
Commercial teleconsultation	14,55%	14,76%	13,77%	16,02%
Improving current economic situation				
Telestroke ward	35,42%	29,99%	33,82%	44,88%
Drip-and-ship	38,93%	43,02%	40,97%	31,47%
Commercial teleconsultation	25,65%	26,99%	25,21%	23,65%
Improving hospital reputation				
Telestroke ward	68,41%	68,81%	68,01%	66,95%
Drip-and-ship	18,44%	18,16%	18,57%	19,11%
Commercial teleconsultation	13,15%	13,03%	13,42%	13,94%
Improving employee satisfaction				
Telestroke ward	43,76%	53,27%	27,47%	51,04%
Drip-and-ship	25,79%	19,52%	40,41%	21,77%
Commercial teleconsultation	30,44%	27,21%	32,12%	27,19%